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Evaluation of the RBC Process for Municipal Wastewater Treatment

Pewaukee, Wis

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16. ABSTRACT

The major objective of this study was to operate a full scale rotating biological contactor (RBC) to determine if it could produce an effluent that would meet the definition of a secondary effluent (BOD <30 mg/l; TSS <30 mg/l). An additional objective was to compare the performance and effluent quality of a RBC system with a full scale trickling filter operating in a parallel mode on the same influent wastewater.

A secondary objective was to evaluate the effectiveness of chemical addition (alum and ferric chloride) to remove phosphorus and determine its effect on operating performance.

The following results were determined from these studies.

(1) The effluent from the RBC process met and exceeded the standards for secondary treatment.
(2) The RBC process gave a superior effluent qualtiy in regard to BOD and TSS than the trickling filter.
(3) Chemical addition to the RBC process was effective for removing phosphorus.
(4) Chemical addition in the RBC process showed a deleterious effect on BOD and TSS removal.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Wastewater* Trickling Filter Nitrification Alum	Temperature Variation RBC Phosphorus Removal Ferric Chloride	13B

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of that environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment of public drinking water supplies, and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research; a most vital communications link between the researcher and the user community.

The case history documented herein is intended to provide the sanitary engineering community with design and operating information on the utilization of the rotating biological contactor process for municipal wastewater treatment.

Francis T. Mayo, Director
Municipal Environmental Research
Laboratory

ABSTRACT

The rotating biological contactor (RBC) process was evaluated for municipal wastewater treatment in a two-phase study conducted at the 1779 m^3/day (0.47 mgd) Pewaukee, Wisconsin wastewater treatment plant. The Phase I study demonstrated and evaluated the effectiveness and efficiency of the RBC process and compared its performance with a parallel 1136 m^3/day (0.30 mgd) trickling filter. The Phase II study demonstrated and evaluated phosphorus removal and treatment upgrading by mineral addition of different cation species (i.e. alum and ferric chloride) to the RBC process at two different feed points upstream and downstream from the RBC units.

Phase I results indicated that superior BOD and SS effluent values were obtained with the RBC process but that better nitrification was achieved by the trickling filter. Neither attached growth process exhibited significant phosphorus removal efficiencies.

Phase II results indicated that mineral addition improved RBC phosphorus removal but resulted in a deterioration of effluent BOD and SS values, regardless of the location of mineral addition or the cation species employed for phosphorus removal.

This report was submitted in fulfillment of Grant No. S802905 by the Village of Pewaukee under the partial sponsorship of the U.S. Environmental Protection Agency. This report covers the period from 1971 to 1976, and work was completed as of January 31, 1976.

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SECTION I

INTRODUCTION

The Village of Pewaukee, Wisconsin is the site of a 1779 m^3/day (0.47 MGD) wastewater treatment plant incorporating the rotating biological contactor (RBC) process for secondary biological treatment. The Pewaukee facility is the first municipal wastewater treatment plant in the U.S. to utilize the RBC process on a full-scale basis. The RBC portion of the treatment plant was constructed and evaluated with Environmental Protection Agency (EPA) demonstration grant funds. The demonstration project was divided into two phases, as reported below. This report presents the results of both phases of the study.

PHASE I

The Phase I study commenced on December 1, 1971, and continued for a one-year period. The study was conducted jointly by the Village of Pewaukee and Autotrol Corporation.* The objectives of this portion of the study were to demonstrate and evaluate the effectiveness and efficiency of the RBC process for treating municipal wastewater on a plant scale basis and to compare its performance with the existing trickling filter. Operating variables investigated included rotational disc velocity, hydraulic loading and wastewater temperature.

PHASE II

The Phase II study commenced on September 23, 1974, and continued for approximately one and one-half years. The study was conducted jointly by the Village of Pewaukee and the Marquette University Engineering Research Foundation. The purpose of this portion of the study was two-fold, as follows:

1. To demonstrate and evaluate phosphorus removal by mineral addition to the RBC process.
2. To demonstrate and evaluate overall treatment upgrading by mineral addition to the RBC process.

Both aluminum sulfate and ferric chloride were evaluated at two different injection points upstream and downstream from the RBC units. The objectives of the study were to consistently produce an effluent phosphorus concentration below 1.5 mg/l (total P) and biochemical oxygen demand (BOD) and suspended solids (SS) levels below 15 mg/l.

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*Autotrol Corporation, 5888 North Glen Park Road, Glendale, WI 53209

SECTION 2

CONCLUSIONS

Based on the results observed during this study, the following conclusions are presented.

PHASE I

1. The RBC process produced an effluent of satisfactory BOD and SS quality, averaging 20 and 15 mg/l, respectively.

2. The RBC process achieved an average BOD removal efficiency of 83 percent.

3. The trickling filter process produced inconsistent effluent BOD and SS concentrations, averaging 38 and 50 mg/l, respectively.

4. RBC process performance was not appreciably affected by variations in raw wastewater temperature between 3.9°C (39°F) and 19.4°C (67°F).

5. Trickling filter process performance was affected by raw wastewater temperature between 3.9°C and 19.4°C, with process deterioration at the lower temperatures.

6. BOD removal efficiency improved with increasing influent BOD concentration applied to the RBC process.

7. Both attached growth processes exhibited poor and inconsistent phosphorus removal efficiencies, varying from a 21 percent average for the RBC process to a 27 percent average removal for the trickling filter.

8. The trickling filter consistently achieved significantly better nitrification than the RBC process.

PHASE II

1. The addition of mineral salts to the RBC process resulted in a deterioration of effluent BOD and SS quality, averaging 35 and 56 mg/l, respectively.

2. The addition of mineral salts to the RBC process resulted in a decreased effluent phosphorus concentration averaging 3.0 mg/l, but the desired project objective of 1.5 mg/l total P was not achieved.

3. RBC process efficiency, as measured by BOD removal, was considerably lower than Phase I performance (i.e. 63 percent compared to 83 percent); this observation was verified by COD and TOC measurements.

4. Neither mineral salt studied provided a significant advantage over the other relative to phosphorus removal.

SECTION 3

RECOMMENDATIONS

Based on the results of this study, the following recommendations are made.

1. Mineral salt addition after the RBC process is advised for phosphorus removal, with close control over any side streams such as digester supernatant that may adversely affect the process. Either iron or aluminum salts may be utilized.

2. Filtration or polymer addition to enhance removal of precipitated phosphorus should be investigated as a means to achieve desired effluent phosphorus levels if mineral salts are added.

SECTION 4

PLANT DESCRIPTION

GENERAL

Schematic flow diagrams of the Pewaukee wastewater treatment plant are presented in Figures 1 and 2. Raw wastewater enters the plant through a diversion manhole which divides the flow between the trickling filter plant (1136 m^3/day design flow) and the RBC plant (1779 m^3/day design flow).

RBC Plant (Figure 1)

Raw wastewater enters the RBC plant through a 15.2 cm (6 in.) Parshall flume and a comminutor into a wet well. Wastewater is pumped by three 25.2 l/sec (400 gpm) pumps to the primary portion of the combined primary and secondary clarifier. A 11.0 m (36 ft.) diameter by 2.1 m (7 ft.) deep inner section serves as the secondary clarifier and a 2.0 m (6.5 ft.) wide by 2.1 m (7 ft.) deep outer annular ring serves as the primary clarifier. A single rotating bridge with two scraper mechanisms collects settled solids from both the primary and secondary sections. The primary clarifier is designed for a surface overflow rate of 22.6 m^3/day/m^2 (554 gpd/ft^2) and the secondary clarifier is designed for a surface overflow rate of 20.5 m^3/day/m^2 (503 gpd/ft^2).

Primary effluent flows by gravity to the RBC units where the flow stream is divided into two parallel paths which pass through four stages of treatment. Each stream is distributed along the length of the first shaft of discs by a V-notch weir. Mixed liquor in each stage of treatment flows over a flat-edge weir to the subsequent adjacent stage. Total head loss through the four stages of treatment is approximately 10.2 cm (4 in.).

The effluents from the two parallel paths of treatment are combined after the RBC units and flow by gravity to the secondary portion of the combined primary and secondary clarifiers. Effluent from the secondary clarifier is chlorinated prior to discharge into the Pewaukee River.

Sludge is drawn from the secondary clarifier by an automated valve and flows by gravity to the wet well of the plant. A recirculation pump is available to recycle secondary sludge to the RBC units. Raw wastewater pumps lift the mixture of raw wastewater and secondary sludge to the primary clarifier where settling occurs, and the combined primary and secondary sludge is pumped on an intermittent basis to the aerobic digester.

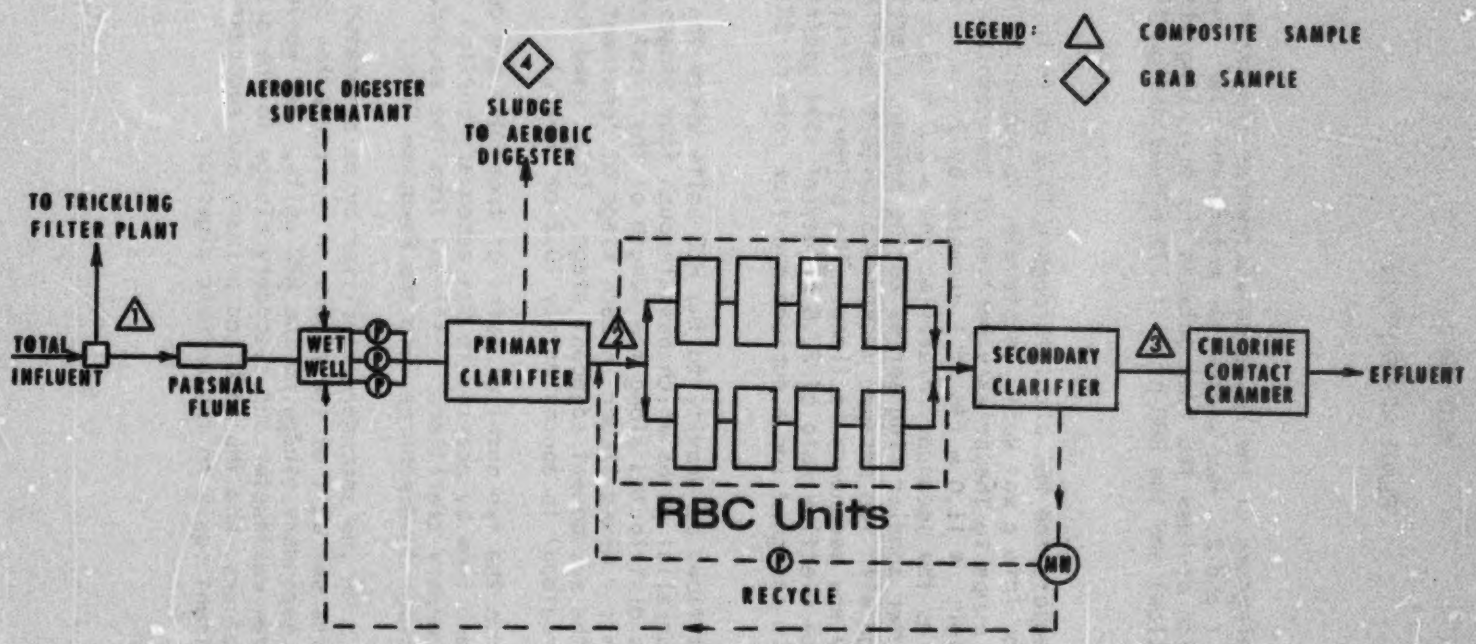
LEGEND:
COMPOSITE SAMPLE
GRAB SAMPLE
TO TRICKLING FILTER PLANT
TOTAL INFLUENT
1
PARSNALL FLUME
AEROBIC DIGESTER SUPERNATANT
WET WELL
P
PRIMARY CLARIFIER
4
SLUDGE TO AEROBIC DIGESTER
2
RBC Units
P
RECYCLE
MN
SECONDARY CLARIFIER
3
CHLORINE CONTACT CHAMBER
EFFLUENT

Figure 1. Schematic flow diagram: RBC Plant, Village of Pewaukee, WI.

The aerobic digester consists of a 9.8 m (32 ft.) diameter by 3.7 m (12 ft.) liquid depth single stage covered unit equipped with a 14.9 kw (20 HP) floating surface aerator. The unit is designed for a liquid detention time of 28.5 days. Digester supernatant is drawn off intermittently by means of a telescopic valve and flows by gravity to the raw wastewater wet well.

Digested sludge is dewatered on sand drying beds prior to disposal by landfill. A drawoff line is available for alternate hauling of wet sludge.

Trickling Filter Plant (Figure 2)

Raw wastewater entering the trickling filter plant is metered by a 15.2 cm (6 in.) Parshall flume prior to being pumped to the primary clarifier unit by three 25.2 l/sec (400 gpm) wastewater pumps. The primary clarifier consists of a rectangular unit 13.1 m (43 ft.) long by 3.7 m (12 ft.) wide by 2.8 m (9.25 ft.) deep and is designed for a surface overflow rate of 23.6 $m^3/day/m^2$ (580 gpd/ft^2).

Primary effluent flows by gravity to a 21.3 m (70 ft.) diameter by 1.7 m (5.7 ft.) deep stone media filter equipped with a fiberglass cover. Effluent from the trickling filter is settled in a rectangular secondary clarifier identical to the primary clarifier and discharged to the Pewaukee River.

Secondary sludge is returned to the raw wastewater wet well. Primary sludge is pumped to a single stage anaerobic digestor. Digestor supernatant is returned to the raw wastewater wet well.

RBC UNITS

Physical Description

The RBC units are enclosed in a 15.2 m (50 ft.) by 18.3 m (60 ft.) building which protects the discs from potential damage due to wind, precipitation, vandalism, or freezing temperatures.

A total of eight shafts, each 5.5 m (18 ft.) long, are located in the RBC building. Mounted on each shaft are 150 polystyrene discs spaced at 3.4 cm (1.33 in.) centers. The discs, each 3.0 m (10 ft.) in diameter by 1.3 cm (0.5 in.) thick provide 14.1 m^2 (152 ft^2) of surface area per disc for biological growth, for a total surface area of 2118 m^2 (22,800 ft^2) per shaft.

The shafts are mounted in semicircular concrete tanks, which conform to the shape of the discs, and are arranged in two parallel paths of four shafts each. Wastewater flow is perpendicular to the shafts and each shaft provides an individual biological treatment stage.

Each shaft is driven independently by a drive system consisting of a 1.1 kw (1.5 HP) motor, helical gear reducer, and chain and sprocket final drive capable of discs speed variations between 0.75 to 2.0 rpm.

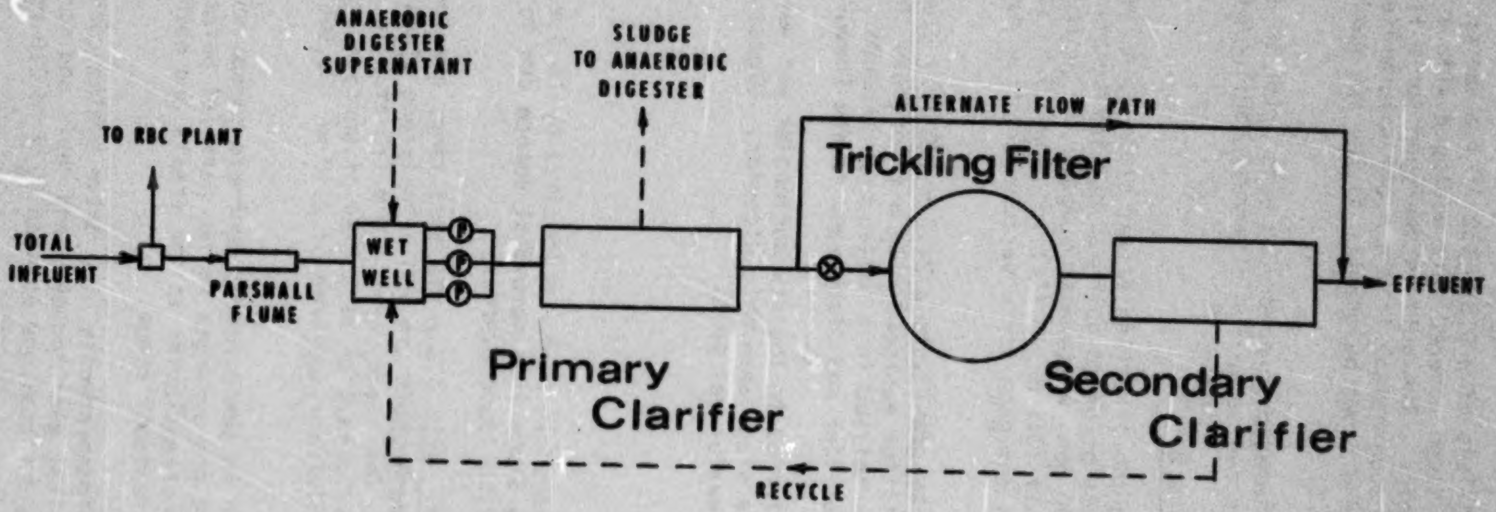
TOTAL INFLUENT
TO RBC PLANT
PARSHALL FLUME
ANAEROBIC DIGESTER SUPERNATANT
WET WELL
P
P
P
SLUDGE TO ANAEROBIC DIGESTER
Primary Clarifier
ALTERNATE FLOW PATH
Trickling Filter
Secondary Clarifier
EFFLUENT
RECYCLE

Figure 2. Schematic flow diagram: Trickling Filter Plant, Village of Pewaukee, WI.

Process Description

The RBC process is classified as an attached growth biological reactor. Initially, slow rotation of the partially submerged (i.e. approximately one-half of the disc diameter) discs in the wastewater results in the gradual growth of an attached microbial culture, reaching a thickness of 2 to 4 mm after approximately 1 week of operation. Continued rotation of the shaft results in oxidation of organic matter in the applied wastewater. Rotation also provides a low energy means of aeration by exposing a thin film of wastewater on the disc surfaces to the air.

Excess biomass generated by organic carbon metabolism of the attached culture is continuously sloughed off by the shearing forces exerted as the discs are rotated through the wastewater. Mixing provided by the rotating shafts keeps the sloughed biomass in suspension until this mixed liquor stream is processed by subsequent secondary clarification.

DESIGN DATA

A summary of the detailed design data for the RBC plant is presented in Appendix A. The plant is designed for an overall BOD removal of 90 percent, with the primary clarifier expected to remove 30 percent of the applied BOD and the RBC process expected to remove 86 percent of the remaining BOD. Expected effluent quality is approximately 23 mg/l of BOD. An overall suspended solids removal of 95 percent is anticipated, resulting in an average effluent SS concentration of 18 mg/l.

Design data for the trickling filter plant are presented in Appendix B.

SECTION 5

TESTING PROGRAM

PHASE I

The Phase I sampling points are indicated on Table I. Composite samples were obtained daily from Sunday through Thursday of each week at the frequencies indicated in Table I. Raw wastewater and biological process effluents were manually composited by obtaining and mixing three daily grab samples obtained in the morning, noon and afternoon of each day. All samples were refrigerated prior to analysis.

The Phase I testing schedule is presented in Table 2. The indicated analytical techniques were performed in accordance with the 13th Edition of Standard Methods.

PHASE II

Phase II sampling points are indicated on Figure I and described in Table 3. Automatic composite samples were obtained daily from Sunday through Thursday of each week. Raw wastewater samples were composited proportional to flow by means of a bucket-type sampler located in the raw influent channel prior to the point where the flow is split between the two plants. The bucket sampler was calibrated to collect one sample for every 37.9 m^3 (10,000 gallons) of wastewater entering the plant. Primary and final effluent samples were composited on a timed basis, with a sample collected for compositing every 15 minutes. A single grab sample of undigested primary sludge was obtained daily from Monday through Friday, timed to coincide with sludge withdrawal from the primary clarifier to the aerobic digester.

All analyses were performed at the Marquette University Engineering Research Foundation Environmental Laboratory with the exception of those tests which were conveniently measured at the plant (i.e. D.O., temperature and pH). The Phase II testing schedule is presented in Table 4. All analyses were performed in accordance with the appropriate sections of the 13th Edition of Standard Methods.

TABLE I. SAMPLING DESCRIPTION, VILLAGE OF PEWAUKEE STUDY, PHASE I

	SAMPLE IDENTIFICATION			
	Raw Wastewater	Primary Effluent	Biological Process Effluent	Final Effluent
Sampling Method	Automatic Composite	Automatic Composite	Manual Composite	Automatic Composite
Sampling Frequency	1 Hour Intervals	1 Hour Intervals	3 Times Daily	1 Hour Intervals
RBC Sampling Point	Diversion Manhole	RBC Influent Trough	RBC Effluent Trough	Secondary Clarifier Outfall Line
Trickling Filter Sampling Point	Diversion Manhole	Primary Clarifier Effluent Trough	Trickling Filter Effluent Trough	Secondary Clarifier Outfall Line

TABLE 2. TESTING SCHEDULE, VILLAGE OF PEWAUKEE STUDY, PHASE I

ANALYSES	ANALYTICAL FREQUENCY, PER WEEK			
	Raw Wastewater	Primary Effluent	Biological Process Effluent	Final Effluent
BOD_5	5	5	2	5
(1) BOD_5, Carbonaceous	0-2	0-2	0-2	0-2
(2) COD	5	5	-	-
(3) Cl_2 Demand	-	-	-	0-1
TSS	2	2	1	2
TVSS	1	1	1	1
TKN	2	2	2	2
NH_3-N	2-5	2-5	2-5	2-5
NO_2 & NO_3-N	1-2	1-2	1-2	1-2
Total P	2	2	-	2
Total Filtrable P	2	2	-	2
Ortho P	2	2	-	2
Temp.	7	7	7	7
pH	5-7	5-7	5-7	5-7
Setteable Solids (volumetric)	7	7	7	7
D.O. (probe)	5	5	5	5

NOTE:
(1) 0.5 mg/l allylthiourea added.
(2) June, 1972 through December, 1972 only.
(3) Trickling filter effluent only.

TABLE 3. SAMPLING DESCRIPTION, RBC PROCESS, VILLAGE OF PEWAUKEE STUDY, PHASE II

	SAMPLE IDENTIFICATION			
	Raw Wastewater	Primary Effluent	Final Effluent	Undigested Sludge
Sampling Method	Automatic Composite	Automatic Composite	Automatic Composite	Grab Sample
Sampling Frequency	1/2 Hour Intervals	1/2 Hour Intervals	1/2 Hour Intervals	Once Daily
* Sampling Point	Diversion Manhole (1)	RBC Influent Trough (2)	Secondary Clarifier Outfall Line (3)	Sludge Pump Discharge Line (4)

* Numbers in parentheses refer to sampling point location shown in Figure 1.

TABLE 4. TESTING SCHEDULE, VILLAGE OF PEWAUKEE STUDY, PHASE II

	ANALYTICAL FREQUENCY, PER WEEK			
ANALYSES	Raw Wastewater	Primary Effluent	Final Effluent	Undigested Sludge
BOD_5	3	3	3	-
COD	2	2	2	-
TOC	5	5	5	-
TSS	5	5	5	-
TS	-	-	-	-
VS	-	-	-	5
Total P	5	5	5	5
Soluble P	-	1	5	-
(1) TKN	5	5	5	-
(1) NH_3-N	5	5	5	-
NO_3-N	-	-	5	-
Alkalinity	2	-	2	-
pH	7	-	7	-
Temperature	7	-	7	-
(2) D.O.		(See Note (2))		
(3) Al	-	-	2	-
(3) Fe	-	-	2	-

NOTES:
(1) June 1975 through December 1975 only.
(2) Monitored 5 days per week at Stages 1 & 4 of RBC unit.
(3) Monitored only when added for P removal.

SECTION 6

TEST RESULTS

PHASE I

Phase I data are summarized in Tables 5 to 9, Figures 3 and 4, and Appendices C and D. A brief discussion of the data classified according to significant categories is presented below.

BOD and Suspended Solids

RBC Process--

Summary of operation -- Table 5 summarizes monthly RBC process operation during Phase I of the study. Effluent BOD and suspended solids averaged 20 and 15 mg/l, respectively, which are well within expected conventional biological wastewater treatment levels of 30 mg/l for both variables. Further examination of the data indicates that average monthly BOD and SS values were both consistently below 30 mg/l and that plant performance was not significantly effected by wastewater temperature. The annual average flow of 1154 m^3/day (305,000 gpd) was well within the average design flow of 1779 m^3/day (470,000 gpd), which was not exceeded during any month on an average basis.

The RBC unit achieved an average BOD removal of 83 percent for the one year period studied. Total plant BOD removal also averaged 83 percent during this period.

Effect of BOD concentration on process efficiency -- Figure 3 presents the effect of influent BOD concentration (i.e. primary effluent BOD) on RBC process BOD removal, with wastewater temperature indicated as a parameter. In order to cover temperature extremes and investigate what effect, if any, that wastewater temperature had on process efficiency, data were selected for the two warmest months (i.e. August and September) and the two coldest months (i.e. February and March). Wastewater temperatures averaged 18.3 and 17.9°C in August and September and 8.3 and 8.2°C in February and March.

The data indicate more efficient BOD removals at higher influent BOD concentrations. The data do not indicate a significant temperature effect in the wastewater temperature range encountered.

Effect of hydraulic loading on process efficiency -- The effect of hydraulic loading on RBC process efficiency is presented in Figure 4.

TABLE 5. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, PHASE I, 1972

Month	Raw Water Temp. °C	Avg. Flow m^3/day	B O D mg/l			Percent BOD Removal		S.S. mg/l			Hydraulic Loading m^3/day/1000 m^2	Organic Loading *
			Raw	Primary	Final	Total	RBC	Raw	Primary	Final		
JAN.	9.2	723	167	150	24	86	84	163	79	17	42.8	8.20
FEB.	8.3	715	146	147	16	89	89	142	83	13	42.4	6.20
MAR.	8.2	1083	145	129	27	81	79	143	103	20	64.0	8.25
APR.	9.2	1098	105	100	22	79	78	100	91	18	64.8	6.49
MAY	11.8	1313	110	100	17	85	83	116	77	15	77.4	7.76
JUNE	15.7	852	126	110	14	89	87	107	78	11	50.1	5.51
JULY	17.3	999	98	110	14	86	87	111	79	14	59.1	6.49
AUG.	18.3	1060	80	108	19	76	82	95	134	16	62.8	6.73
SEPT.	17.9	1643	94	158	23	75	85	107	252	21	97.0	15.32
OCT.	15.7	1298	95	90	18	81	80	70	75	14	76.6	6.88
NOV.	13.0	1317	128	109	23	82	79	108	99	16	77.8	8.44
DEC.	10.9	1749	181	122	21	88	83	--	--	--	103.1	13.52
AVG.	12.9	1154	124	120	20	83	83	115	105	15	62.8	8.15

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

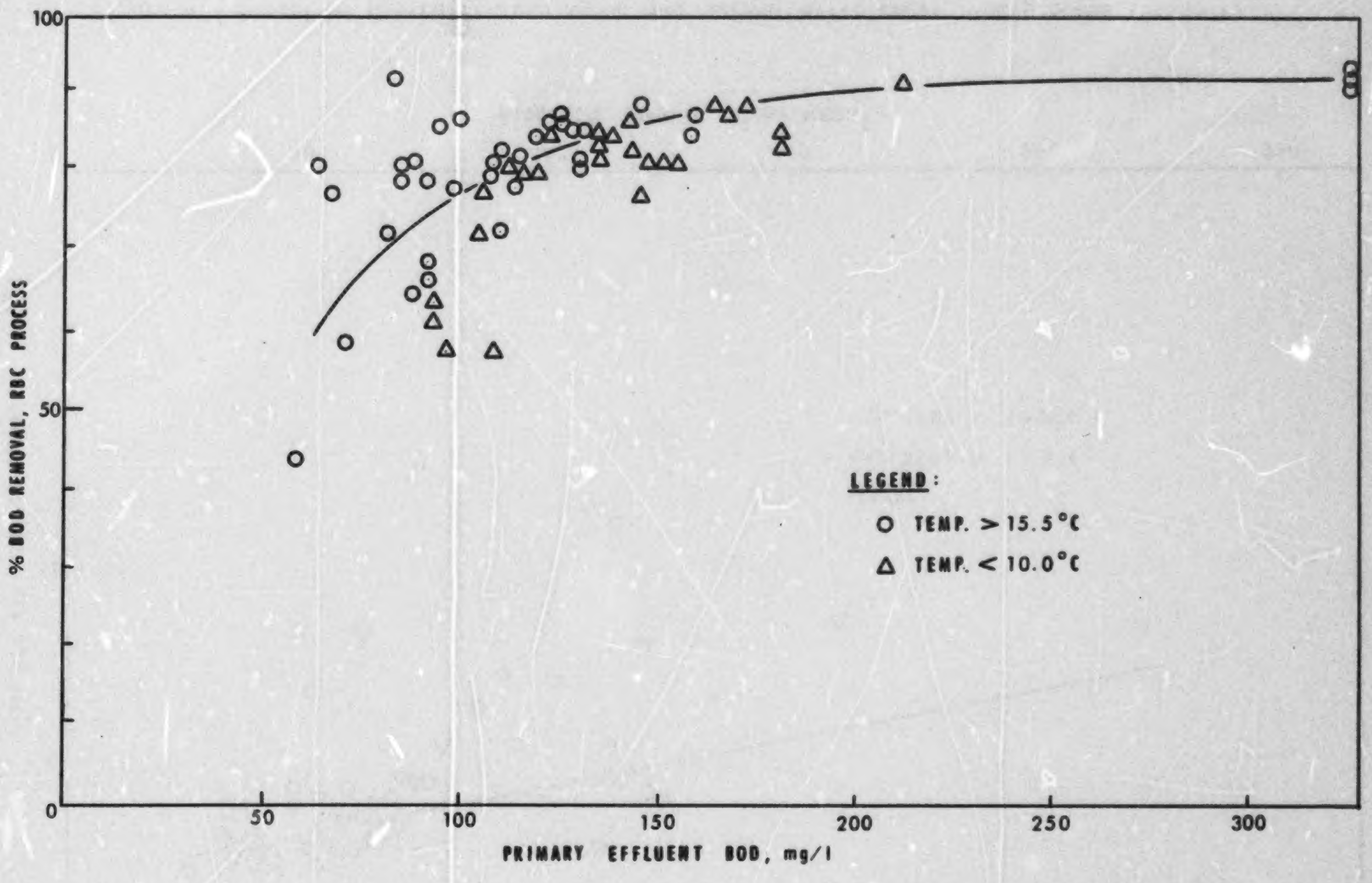

Figure 3. BOD removal efficiency: RBC process (Phase I).

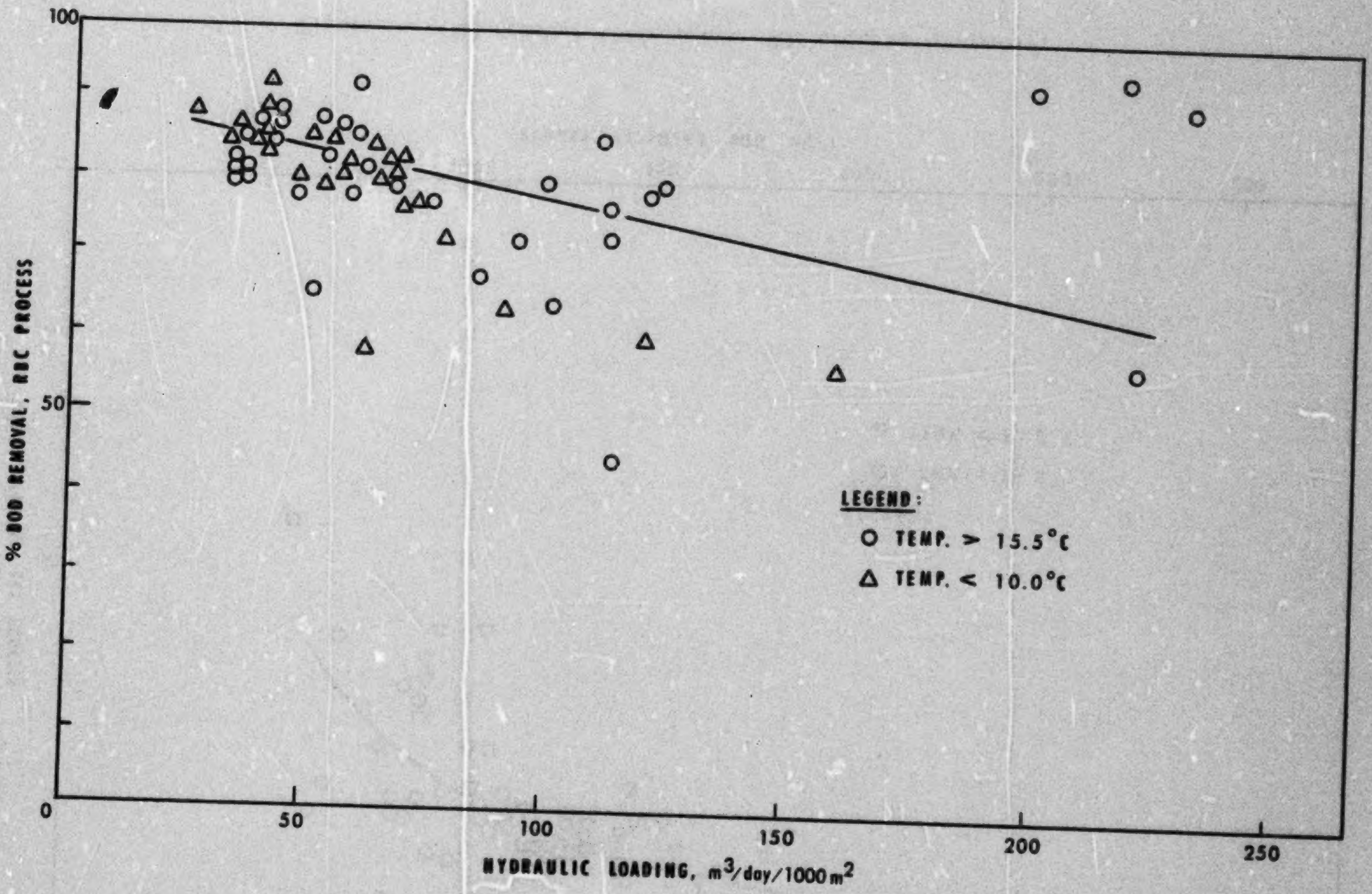

Figure 4. Effect of hydraulic loading on BOD removal efficiency: RBC process (Phase I).

Wastewater temperature is again represented as a parameter, using the same data selected for presentation in Figure 3. The data indicate a decrease in RBC process efficiency at increased hydraulic loading (or decreased retention time), which is consistent with RBC process theory.

Trickling Filter Process--

Summary of operation — Table 6 summarizes monthly trickling filter process operation during Phase I of the study. Effluent BOD and suspended solids values averaged 38 and 50 mg/l, respectively, which were considerably higher than the RBC process effluent levels. Further examination of the data indicates a relationship between process performance and wastewater temperature. The highest process BOD removals of 94 and 80 percent were achieved during July and August when the wastewater temperature averaged 17.3 and 18.3°C, respectively, compared to the lowest process BOD removals of 58 percent during January and February when the wastewater temperature averaged 9.2 and 8.3°C, respectively. Total plant BOD removal averaged 71 percent and trickling filter process removal averaged 70 percent during Phase I.

The annual average flow of 768 m^3/day (203,000 gpd) was less than the average design flow of 1136 m^3/day (300,000 gpd). During three months of the Phase I study, the average design flow was equalled or exceeded (i.e. August, September and October).

Hydraulic loading to the trickling filter averaged 2.15 m^3/day/m^2 (2.30 mgad) and organic loading averaged 158 g BOD/day per m^3 (9.86 lbs. BOD per 1000 cu. ft. per day). Both of these loadings are characteristic of a standard or low-rate trickling filter. A BOD removal efficiency of 85 to 90 percent is reasonable for this type of filter. However, as indicated by the data in Table 6, this range of removal was achieved only once on a monthly basis during the one year period studied.

Phosphorus

RBC Process--

A detailed summary of Phase I phosphorus data for the RBC plant is presented in Appendix C. Raw wastewater total phosphorus values averaged 8.1 mg/l during the 12 month interval. In comparison, primary effluent total phosphorus values averaged 8.6 mg/l during that same period, indicating the possible influence of aerobic digester supernatant on phosphorus levels. Final effluent total phosphorus values averaged 6.9 mg/l, of which 6.5 mg/l were filtrable.

The daily percent removals varied considerably, as indicated by the data in Appendix C. Annual total phosphorus removals averaged 14.9 percent for the complete plant and 20.6 percent for the RBC process.

Trickling Filter Process--

Phosphorus data for Phase I trickling filter plant operation are presented in Appendix D. Raw wastewater phosphorus values are the same reported for the RBC plant. Similar to the RBC plant, trickling filter primary effluent total phosphorus values increased over the raw wastewater values, in this

TABLE 6. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE TRICKLING FILTER, PHASE I, 1972

Month	Raw Water Temp. °C	Avg. Flow m^3/day	BOD mg/l			Percent BOD Removal		S.S. mg/l			Hydraulic Loading m^3/day/m^2	Organic Loading *
			Raw	Primary	Final	Total	T.F.	Raw	Primary	Final		
JAN.	9.2	772	167	197	82	51	58	163	170	81	2.16	245
FEB.	8.3	537	146	154	64	56	58	142	196	69	1.51	133
MAR.	8.2	753	145	146	52	64	64	143	146	60	2.10	177
APR.	9.2	749	105	122	37	65	70	100	163	54	2.09	147
MAY	11.8	575	110	97	30	73	69	116	157	51	1.61	90
JUNE	15.7	689	126	130	38	70	71	107	177	63	1.93	144
JULY	17.3	572	98	343	20	80	94	111	778	31	1.60	315
AUG.	18.3	1154	80	91	18	78	80	95	138	32	3.23	169
SEPT.	17.9	1268	94	61	17	82	72	107	69	33	3.54	132
OCT.	15.7	1136	95	84	23	76	73	70	97	34	3.18	153
NOV.	13.0	462	128	68	25	80	63	108	66	40	1.29	50
DEC.	10.9	560	181	155	45	75	71	--	--	--	1.57	140
AVG.	12.9	768	124	137	38	71	70	115	196	50	2.15	158

NOTE: *Organic loading expressed as g primary BOD/day per m^3 of trickling filter volume (i.e. g/day/m^3).

TABLE 7. PHOSPHORUS REMOVAL SUMMARY, VILLAGE OF PEWAUKEE, PHASE I, 1972

Description	RBC PLANT Annual Avg. Conc. mg/l	RBC PLANT Range mg/l	TRICKLING FILTER Annual Avg. Conc. mg/l	TRICKLING FILTER Range mg/l
1. Raw Wastewater				
Total P	8.1	3.0-18.4	8.1	3.0-18.4
Filt. P	6.6	1.0-13.9	6.6	1.0-13.9
Ortho P	3.4	1.2- 8.0	3.4	1.2- 8.0
2. Primary Effluent				
Total P	8.6	4.6-12.2	10.4	3.5-66.0
Filt. P	6.7	2.0-10.1	6.8	2.4-18.0
Ortho P	4.6	1.2- 7.3	4.8	1.1-16.0
3. Final Effluent				
Total P	6.9	2.4-10.3	7.6	3.3-11.2
Filt. P	6.5	2.1- 9.2	6.5	2.6- 9.8
Ortho P	5.1	1.3- 7.4	4.8	1.9- 7.9
Avg. Per Cent Removal (Total P)	14.9 (over-all) 20.6 (RBC only)		5.8 (over-all) 26.6 (T.F. only)	

case averaging 10.4 mg/l. Although this value is considerably higher than the corresponding RBC primary effluent total phosphorus value, the filtrable phosphorus values are approximately the same, averaging 6.8 mg/l for the trickling filter and 6.7 mg/l for the RBC plant. The influence of anaerobic digester supernatant on nonfiltrable phosphorus levels is indicated by the data.

Final effluent total phosphorus values averaged 7.6 mg/l, of which 6.5 mg/l were filtrable. Annual total phosphorus removals averaged only 5.8 percent for the complete plant, but a more acceptable removal of 26.6 percent was achieved by the trickling filter process.

Process Comparison--

A comparison of phosphorus removal performance for the RBC and trickling filter processes is presented in Table 7. Of significance is the fact that both processes exhibited comparable, though poor, performance and resulted in the same average filtrable effluent phosphorus concentration (i.e. 6.5 mg/l). Thus, neither attached growth process appears to offer an advantage for phosphorus removal.

Nitrogen

RBC Process--

A summary of nitrogen data for the RBC plant during Phase I is presented in Table 8. Raw wastewater total Kjeldahl nitrogen (TKN) averaged 27.3 mg/l

TABLE 8. NITROGEN SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, PHASE I

	MONTHLY AVERAGES, mg/l								
	Raw Wastewater			Primary Effluent			Final Effluent		
Month	TKN	NH_3-N	NO_3-N	TKN	NH_3-N	NO_3-N	TKN	NH_3-N	NO_3-N
Dec. -71	30.2	15.4	1.9	21.8	12.6	0.7	19.3	13.0	0.8
Jan. -72	32.9	15.8	1.1	26.9	17.6	0.9	21.6	16.4	1.3
Feb. -72	30.2	15.4	0.8	30.3	17.5	1.0	17.7	13.1	4.9
Mar. -72	23.6	13.7	0.8	25.4	12.3	0.6	13.1	8.0	3.1
Apr. -72	21.5	12.9	0.7	23.3	13.5	0.6	12.4	8.8	3.9
May -72	22.5	14.0	0.8	20.0	12.1	0.7	8.6	5.6	4.9
June -72	22.5	14.8	0.7	21.4	14.1	0.6	9.5	7.8	3.9
July -72	15.3	10.5	0.2	20.7	13.3	0.3	8.2	7.3	3.6
Aug. -72	19.7	11.7	0.6	24.9	13.5	2.0	9.5	6.5	5.2
Sept.-72	21.2	10.7	1.7	21.9	9.5	0.5	11.9	7.1	2.6
Oct. -72	18.2	11.0	1.3	17.9	10.5	0.8	8.1	6.5	2.9
Nov. -72	26.3	10.7	2.2	22.1	11.7	0.7	13.6	9.0	2.1
Dec. -72	43.6	15.4	1.8	25.6	15.6	0.6	16.9	13.5	1.3
Avg.	27.3	14.3	1.2	25.2	14.5	0.8	14.2	10.2	3.4

during that period, which is within the range of values considered typical for domestic wastewater. Ammonia nitrogen accounts for approximately one-half of the raw wastewater Kjeldahl nitrogen, averaging 14.3 mg/l.

Insignificant changes occurred during primary clarification, as indicated by the same approximate average nitrogen values for the primary effluent and the raw wastewater. Final effluent ammonia nitrogen and nitrate nitrogen values averaged 10.2 and 3.4 mg/l, indicating that some nitrification took place.

Trickling Filter Process--

A summary of nitrogen data for the trickling filter plant during Phase I is presented in Table 9. Raw wastewater data are identical to those presented in Table 8.

TABLE 9. NITROGEN SUMMARY, VILLAGE OF PEWAUKEE TRICKLING FILTER, PHASE I

	MONTHLY AVERAGES, mg/l								
	Raw Wastewater			Primary Effluent			Final Effluent		
Month	TKN	NH_3-N	NO_3-N	TKN	NH_3-N	NO_3-N	TKN	NH_3-N	NO_3-N
Dec. -71	30.2	15.4	1.9	34.4	20.6	1.1	18.0	10.3	5.5
Jan. -72	32.9	15.8	1.1	28.2	14.2	2.2	16.4	9.4	9.7
Feb. -72	30.2	15.4	0.8	32.7	12.7	0.9	16.9	8.4	8.3
Mar. -72	23.6	13.7	0.8	24.5	10.2	0.8	10.9	4.5	7.5
Apr. -72	21.5	12.9	0.7	26.2	12.1	0.6	9.1	4.9	6.9
May -72	22.5	14.0	0.8	18.4	8.5	1.9	7.3	2.4	9.0
June -72	22.5	14.8	0.7	23.7	13.4	1.4	11.7	5.7	6.1
July -72	15.3	10.5	0.2	19.8	8.3	0.4	10.5	5.0	6.7
Aug. -72	19.7	11.7	0.6	18.7	9.4	0.6	7.7	4.4	5.9
Sept.-72	21.2	10.7	1.7	13.7	7.3	1.4	5.3	2.4	7.5
Oct. -72	18.2	11.0	1.3	16.0	9.9	1.2	5.8	3.4	7.7
Nov. -72	26.3	10.7	2.2	17.9	8.6	2.6	4.7	1.6	10.9
Dec. -72	43.6	15.4	1.8	--	13.8	--	10.6	8.4	9.3
	27.3	14.3	1.2	24.9	12.4	1.4	11.2	5.9	8.4

The effect of primary clarification on nitrogen concentrations is similar to that observed previously for the RBC plant, with generally insignificant changes occurring. Final effluent ammonia nitrogen and nitrate nitrogen values averaged 5.9 and 8.4 mg/l, indicating that significant nitrification occurred.

Process Comparison--

A comparison of nitrification performance for the RBC and trickling filter processes indicates that the trickling filter was consistently more effective in achieving nitrification.

PHASE II

Preliminary Study

Before chemical feed to the RBC units was initiated, a preliminary study was conducted to characterize diurnal variations of the raw wastewater and provide background information on treatment plant performance. The main purposes of this study were to determine the most appropriate sampling techniques and estimate the required chemical feed rates.

Table 10 summarizes preliminary plant performance data for eight selected variables over a period of thirteen consecutive days. Raw influent, primary effluent and final effluent samples were composited over a 24-hour period and the indicated analyses performed on the composites. During this period the influent wastewater averaged 9.2 mg/l total P, the primary effluent averaged 6.2 mg/l and the final effluent averaged 5.9 mg/l. Thus, an average total P removal of approximately 33 percent was achieved by primary clarification, but an average removal of only 6 percent was achieved by the RBC units.

Relatively high average effluent BOD and SS concentrations of 60 mg/l and 43 mg/l, respectively, were observed during this period. BOD removal by the RBC process averaged approximately 58 percent.

Diurnal flow variations were obtained by calculating average hourly flows from continuous flow records; the calculated flows were compared to flow meter totalized flows with good agreement. The flow pattern represented was typical of normal domestic wastewater loadings, with the peak flow occurring during the day and early evening and minimum flow occurring from midnight to 6 AM.

The diurnal variations of COD and SS were also investigated. A pattern similar to that of flow variation was obtained for both variables, with lower concentrations in the early morning compared to higher daytime levels.

The diurnal variation of influent phosphorus was determined for 4 selected days. Significant variation was shown in the daytime levels but a uniformly low loading was evident during the late evening and early morning hours. These data served as the basis for characterizing the phosphorus loading to the plant and subsequent selection of chemical feed rates. The estimated average total phosphorus loading levels were 0.9 kg/hr (2.0 lbs/hr) between 9 AM and 5 PM, 0.5 kg/hr (1.0 lbs/hr) between 5 PM and midnight, 0.1 kg/hr (0.3 lbs/hr) between midnight and 7 AM, and 0.5 kg/hr (1.0 lbs/hr) between 7 and 9 AM.

Operating Conditions

The operating conditions under which mineral addition was to be evaluated are summarized below:

a. Aluminum addition after the RBC units but prior to the secondary clarifier (case I).

TABLE 10. PRELIMINARY PLANT PERFORMANCE DATA, VILLAGE OF PEWAUKEE RBC PLANT, PHASE II

	Analyses of 24 hour Composite Samples					
	SEPTEMBER, 1974					
	23	24	25	26	29	30
pH:						
Raw	7.4	7.5	7.2	7.4	7.3	7.3
Primary	7.3	7.4	7.1	7.5	7.4	7.4
Final	8.0	7.7	7.2	7.5	7.3	7.4
B.O.D. mg/l:						
Primary	184	127	193	72	86	80
Final	62	65	61	31	42	45
Total Phosphorous mg/l:						
Raw	7.5	9.0	9.0	7.5	11.0	6.8
Primary	8.0	7.2	6.2	5.5	4.6	6.0
Final	7.0	9.5	6.2	6.0	4.7	6.0
Susp. Solids mg/l:						
Primary	92	76	87	70	54	52
Final	74	78	59	36	18	31
Aluminum mg/l:						
Raw	0.036	0.076	0.076	0.036	0.044	0.050
Primary	0.036	0.006	0.006	0.016	0.024	0.024
Final	0.010	0.012	0.006	0.006	0.006	0.060
Iron mg/l:						
Raw	3.1	12.5	9.2	7.2	8.7	5.3
Primary	2.0	1.1	0.8	0.6	1.2	1.1
Final	2.5	0.4	0.6	0.3	0.6	0.8
Nitrate N mg/l:						
Final	1.90	0.65	0.60	0.45	0.50	0.45
Ammonia N mg/l:						
Final	--	--	--	13.3	--	13.5
Flow m^3/day	651	654	818	783	780	1014

TABLE 10. (continued)

Analyses of 24 hour Composite Samples

OCTOBER, 1974

	01	02	03	07	08	09	10	Avg.*
pH:								
Raw	7.2	7.3	7.4	7.2	7.3	N.S.	7.45	7.3
Primary	7.5	7.5	N.S.	7.5	N.S.	7.5	7.45	7.4
Final	7.5	7.4	7.5	7.5	7.3	7.4	7.4	7.5
B.O.D. mg/l:								
Primary	132	102	N.S.	451	N.S.	97	89	144
Final	55	49	46	171	84	35	44	60
Total Phosphorous mg/l:								
Raw	9.5	9.5	9.0	11.0	11.75	N.S.	6.5	9.2
Primary	5.8	6.0	N.S.	7.0	N.S.	7.2	5.5	6.2
Final	6.2	5.8	6.3	4.5	4.5	5.0	5.7	5.9
Susp. Solids mg/l:								
Primary	67	77	N.S.	198	N.S.	75	64	83
Final	35	63	39	46	42	27	21	43
Aluminum mg/l:								
Raw	0.015	0.025	0.060	0.070	0.060	N.S.	0.010	0.044
Primary	0.026	0.014	N.S.	0.006	N.S.	0.014	0.006	0.016
Final	0.020	0.010	0.026	0.016	0.014	0.018	0.018	0.016
Iron mg/l:								
Raw	5.8	7.7	11.4	25.2	23.8	N.S.	3.8	10.0
Primary	0.8	0.8	N.S.	3.1	N.S.	0.6	0.6	1.1
Final	0.5	0.8	1.4	0.8	0.6	1.0	0.5	0.8
Nitrate N mg/l:								
Final	0.45	0.60	0.95	1.25	0.50	0.34	0.04	0.66
Ammonia N mg/l:								
Final	--	--	--	--	--	--	--	13.4
Flow m^3/day	867	912	901	1090	988	908	1170	886

*Average of 13 Daily Results

b. Aluminum addition prior to the RBC units but after the primary clarifier (case 2).
c. Iron addition after the RBC units but prior to the secondary clarifier (case 3).
d. Iron addition prior to the RBC units but after the primary clarifier (case 4).

In addition, it was decided to evaluate the effect of cation : P molar ratio on phosphorus removal efficiency. Consequently, cation : P molar ratios ranging from 1.35 : 1 to 1.75 : 1 for both aluminum and iron were initially identified for consideration.

Because of the variable nature of the phosphorus loadings indicated in the preliminary study, it was decided to vary the mineral addition rate to correspond to the anticipated phosphorus loading rates. However, because of manpower and equipment limitations, it was not possible to vary the mineral addition rate as often as desired. Instead, the chemical feed pump was adjusted to deliver at (1) a minimum rate (i.e. dependent upon chemical feed concentration and desirable cation:P molar ratio) between 4:30 PM and 7:30 AM when lower phoscphrus loadings were anticipated, and (2) a rate twice the minimum rate between 7:30 AM to 4:30 PM when higher phosphorus loadings were anticipated. This schedule was also selected because it coincided with normal plant operation.

A positive displacement chemical feed pump was used for mineral addition. The pump was capable of feeding both liquid alum and ferric chloride, which were selected as the sources of aluminum and iron. A polyethylene tank located inside the RBC building was utilized for temporary chemical storage. The tank was calibrated and daily observations were made to determine the actual amount of mineral addition. Every time that a new supply of alum or ferric chloride was obtained, a sample was taken and analyzed for either aluminum or iron. In this manner, a precise record of chemical feed strength was obtained.

The schedule followed in Phase II of the study is summarized below:

Date	Chemical Feed Conditions
Jan. 7 - May 6, 1975	Alum feed after RBC units
May 12 - July 20, 1975	Alum feed before RBC units
Aug. 5 - Aug. 28, 1975	Alum feed after RBC units (enhanced mixing)
Sept. 7 - Oct. 30, 1975	Ferric chloride feed after RBC units
Nov. 2 - Dec. 23, 1975	Ferric chloride feed before RBC units

Alum was fed one additional month (i.e. August) after the RBC units in order to evaluate a system of enhanced mixing. A wide range of Al:P and Fe:P ratios were obtained during the study because of the difficulty in predicting influent phosphorus levels.

RBC speed was maintained at 2 rpm, corresponding to a peripheral velocity of approximately 0.3 m/sec (60 fpm), throughout the Phase II test period.

Data Presentation

Phase II data are summarized in Figures 5 to 16, Tables 11 and 12, and Appendices E to G. A brief discussion of the data classified according to significant categories is presented below.

Phosphorus Removal--

Case 1 -- Alum was introduced after the RBC units from January 7 to May 6 and August 5 to 28. A wide range of Al:P molar ratios, varying from approximately 0.4 to 3.5, were obtained.

The effect of Al:P molar ratio on effluent total P concentration is presented in Figure 5. Although a decrease in effluent total P was achieved with increasing Al:P molar ratios, the desired project objective of total P less than 1.5 mg/l was seldom realized and, in fact, a value less than 1.0 mg/l total P was achieved only once, at an Al:P molar ratio of 2.72.

The effect of Al:P molar ratio on effluent ortho-P concentration is presented in Figure 6. This plot demonstrates that ortho-P concentrations below 1.5 mg/l were consistently achieved at an Al:P molar ratio of approximately 1.0 or greater. These data, when compared to total P data, suggest the need for either improved clarification or filtration to achieve desirable effluent P limits.

Case 2 -- Alum was fed prior to the RBC units from May 12 to July 20. A wide range of Al:P ratios, varying from approximately 0.2 to 3.2, were obtained.

The effect of Al:P molar ratio on effluent total P concentration is presented in Figure 7. Once again, a decrease in effluent total P with increasing Al:P values is evident, but the desired project objective of 1.5 mg/l total P was not consistently achieved. In this case, not a single effluent value less than 1.0 mg/l total P was realized.

The effect of Al:P molar ratio on effluent ortho-P concentration is presented in Figure 8. As in the Case 1 results, these data suggest potential improvement in effluent P quality with improved secondary solids removal. In this case, an Al:P molar ratio of approximately 1.5 or greater corresponds to effluent ortho-P concentrations less than 1.0 mg/l.

Effluent aluminum data for both Case 1 and Case 2 alum feed conditions were observed. The data generally indicate increasing effluent aluminum concentrations with increasing Al:P molar ratios. However, with the exception of two observations, effluent aluminum concentrations less than 2.5 mg/l were consistently found over a broad range of Al:P molar ratios.

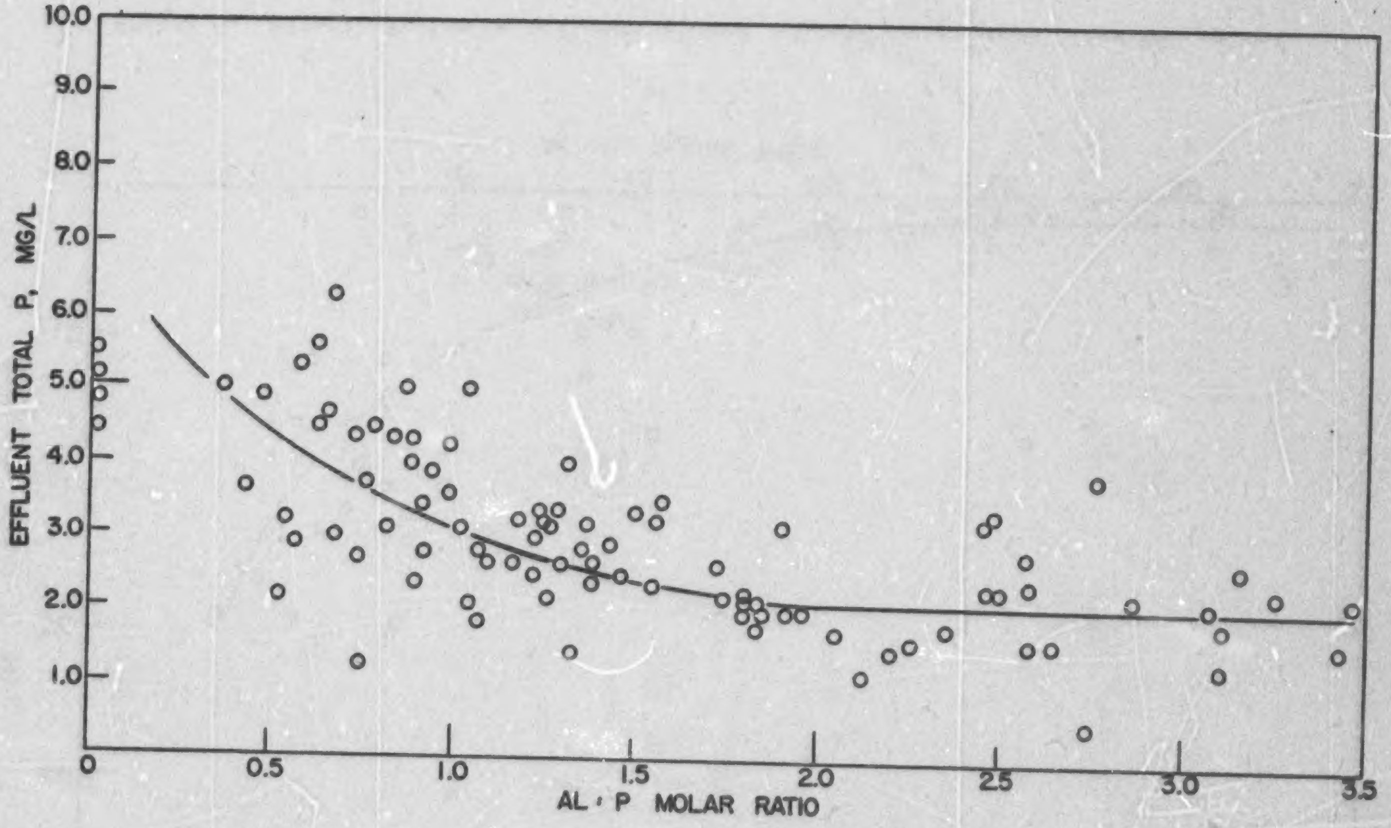

Figure 5. Effect of alum on effluent total P concentration (feed after RBC units).

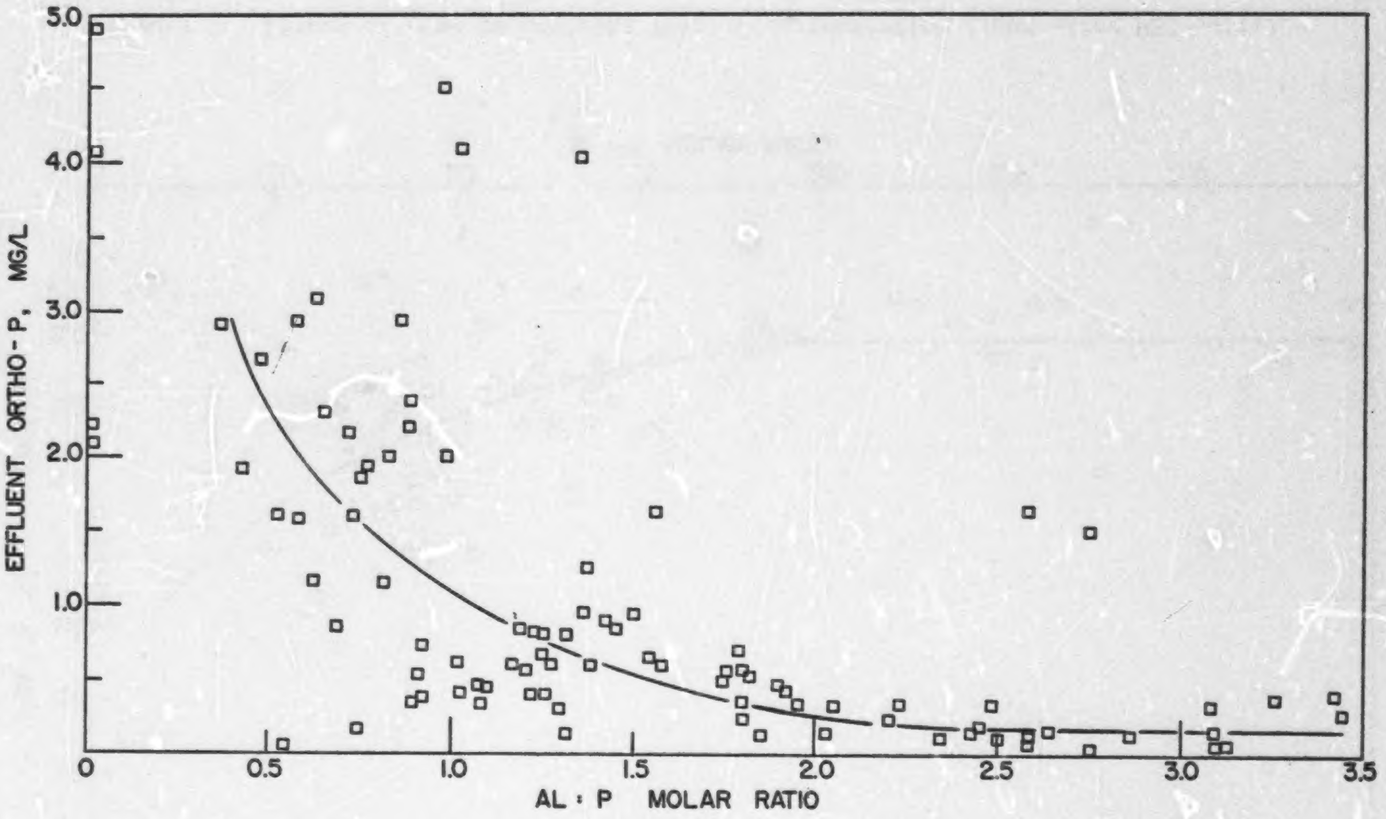

Figure 6. Effect of alum on effluent ortho-P concentration (feed after RBC units).

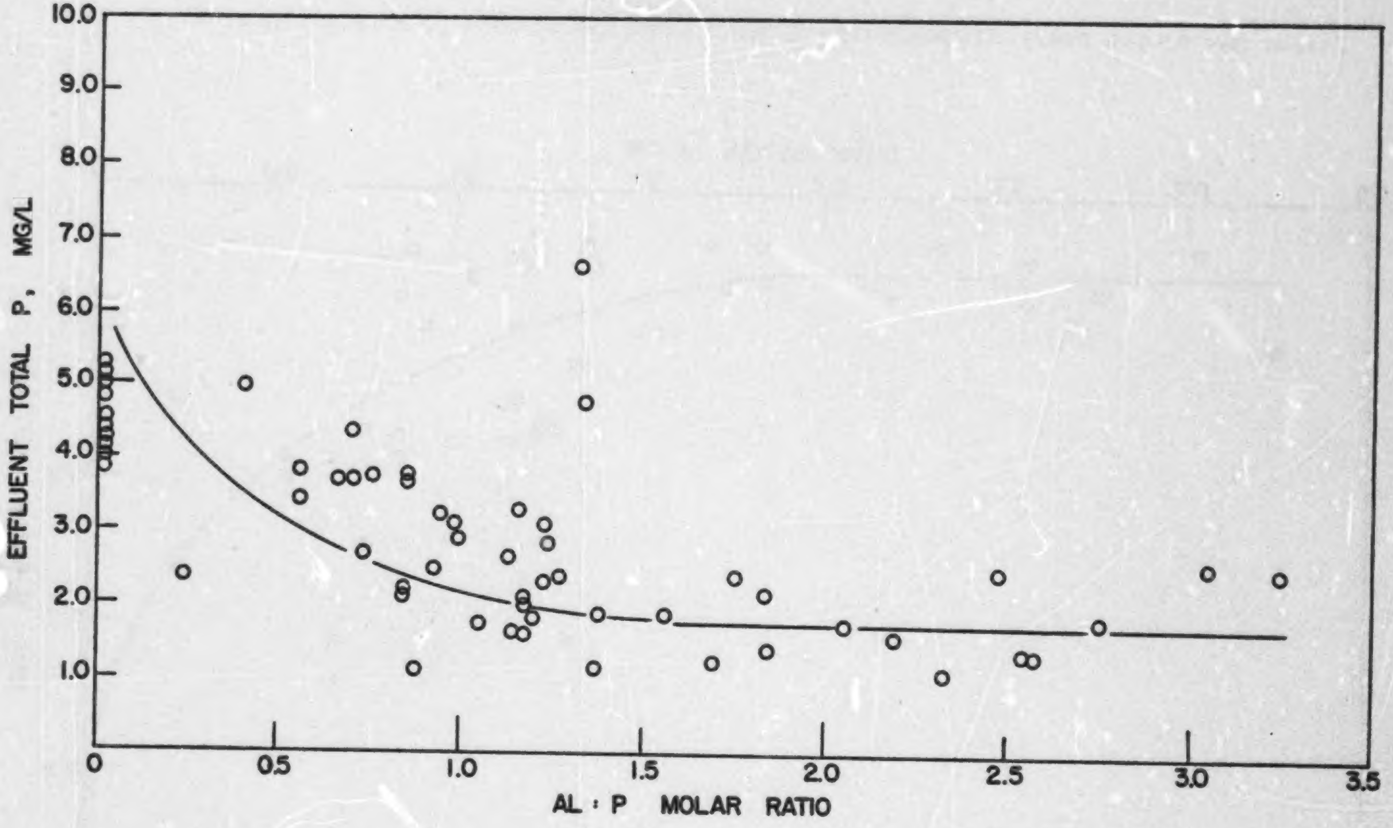

Figure 7. Effect of alum on effluent total P concentration (feed before RBC units).

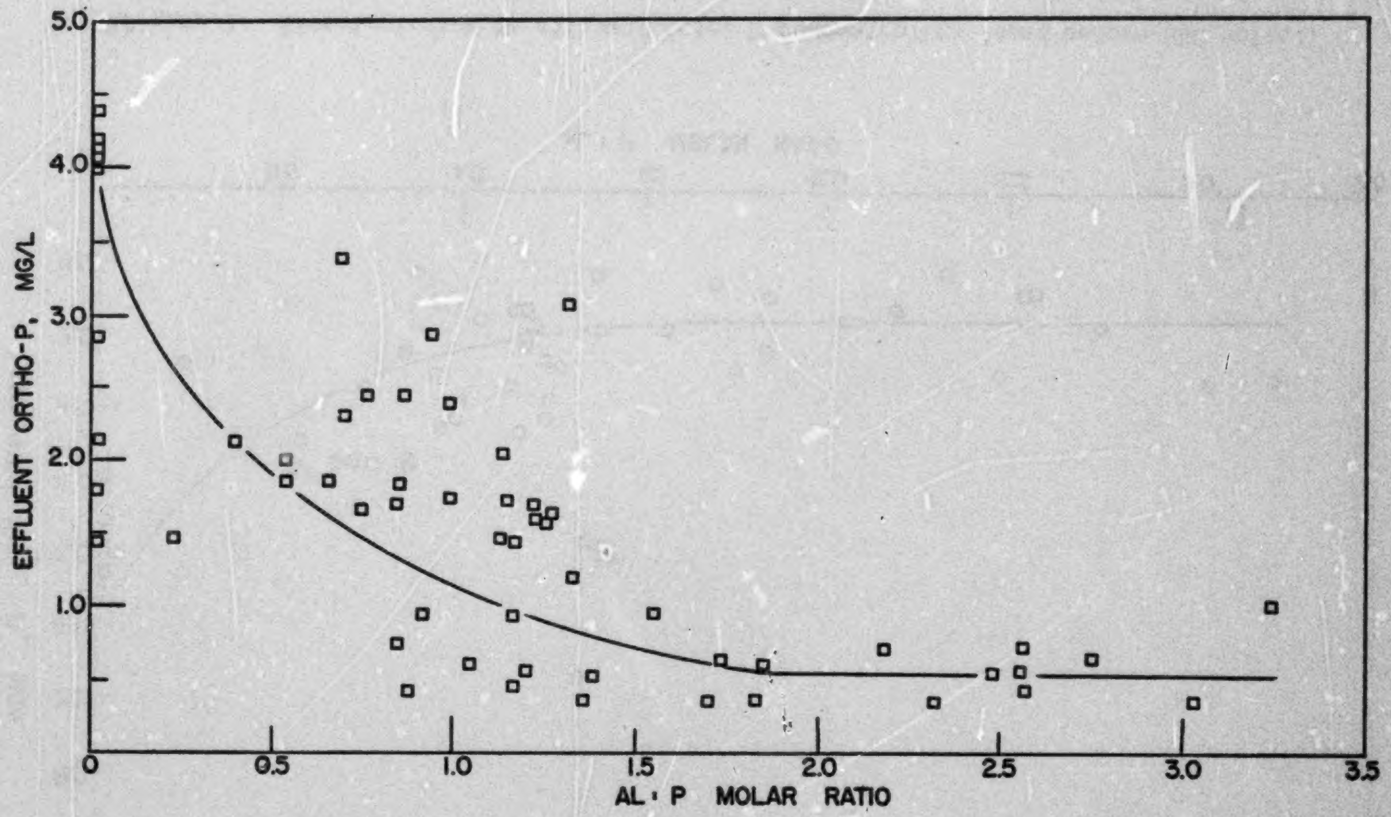

Figure 8. Effect of alum on effluent ortho-P concentration (feed before RBC units).

Case 3 -- Ferric chloride was introduced after the RBC units from September 7 to October 30. A relatively wide range of Fe:P molar ratios, ranging from approximately 0.1 to 1.9, were obtained.

The influence of Fe:P molar ratio on effluent total P concentration is shown in Figure 9. In a pattern similar to that shown for aluminum, decreasing effluent total P concentrations are achieved with increasing Fe:P molar ratios, but the project objective of 1.5 mg/l total P was not consistently realized even at the higher Fe:P values.

Effluent ortho-P concentration is plotted against Fe:P molar ratios in Figure 10. Considerable improvement in effluent P quality is indicated by these data. Significantly low effluent ortho-P concentrations are achieved at Fe:P molar ratios less than 1.0. These data suggest potential achievement of project objectives with improved secondary solids removal.

Effluent iron data for Case 3 ferric chloride feed conditions were determined and a random pattern of effluent iron concentration was observed. Values ranging from approximately 1.0 to 10.0 mg/l Fe were found.

Case 4 -- Ferric chloride was fed prior to the RBC units from November 2 to December 23, 1975 and a short period in January, 1976. A wide range of Fe:P ratios, varying from approximately 0.4 to 2.7 were obtained.

The effect of Fe:P molar ratio on effluent total P concentration is shown in Figure 11. A random variation of the data is evident, accompanied by inconsistent achievement of the project objective of 1.5 mg/l effluent total P.

However, when considering effluent ortho-P data, as presented in Figure 12, once again the potential for improvement in P removal performance with improved secondary solids removal is obvious. The data of Figure 12 are noteworthy because they indicate effluent ortho-P values less than 1.4 mg/l for all Fe:P values. In fact, effluent ortho-P values less than 1.0 mg/l were achieved on all but three days tested.

Organic Removal--

BOD -- Figure 13 presents the effect of influent BOD on RBC process efficiency. These data indicate more efficient BOD removal at higher BOD loadings, although there is a considerable amount of scatter, particularly at the lower influent BOD values.

The effect of hydraulic loading on RBC process BOD removal was also observed. Considerable scatter was evident in the data, but a decrease in RBC process efficiency was indicated at increased hydraulic loading.

The effect of organic loading on RBC process efficiency was investigated but not found to be significant.

TOC -- Total organic carbon (TOC) data were collected in addition to BOD and COD data in order to determine organic removal efficiencies directly

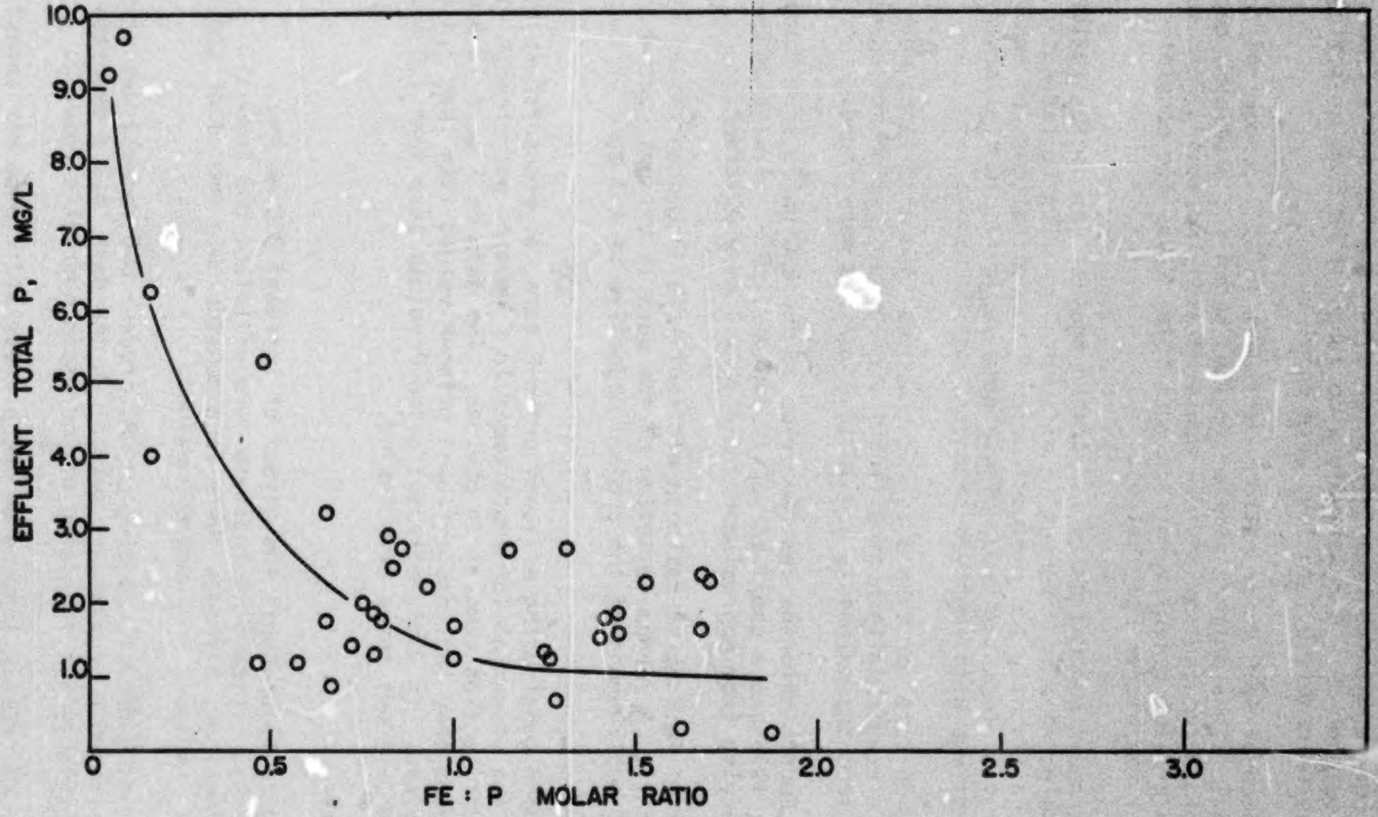

Figure 9. Effect of iron salt on effluent total P concentration (feed after RBC units).

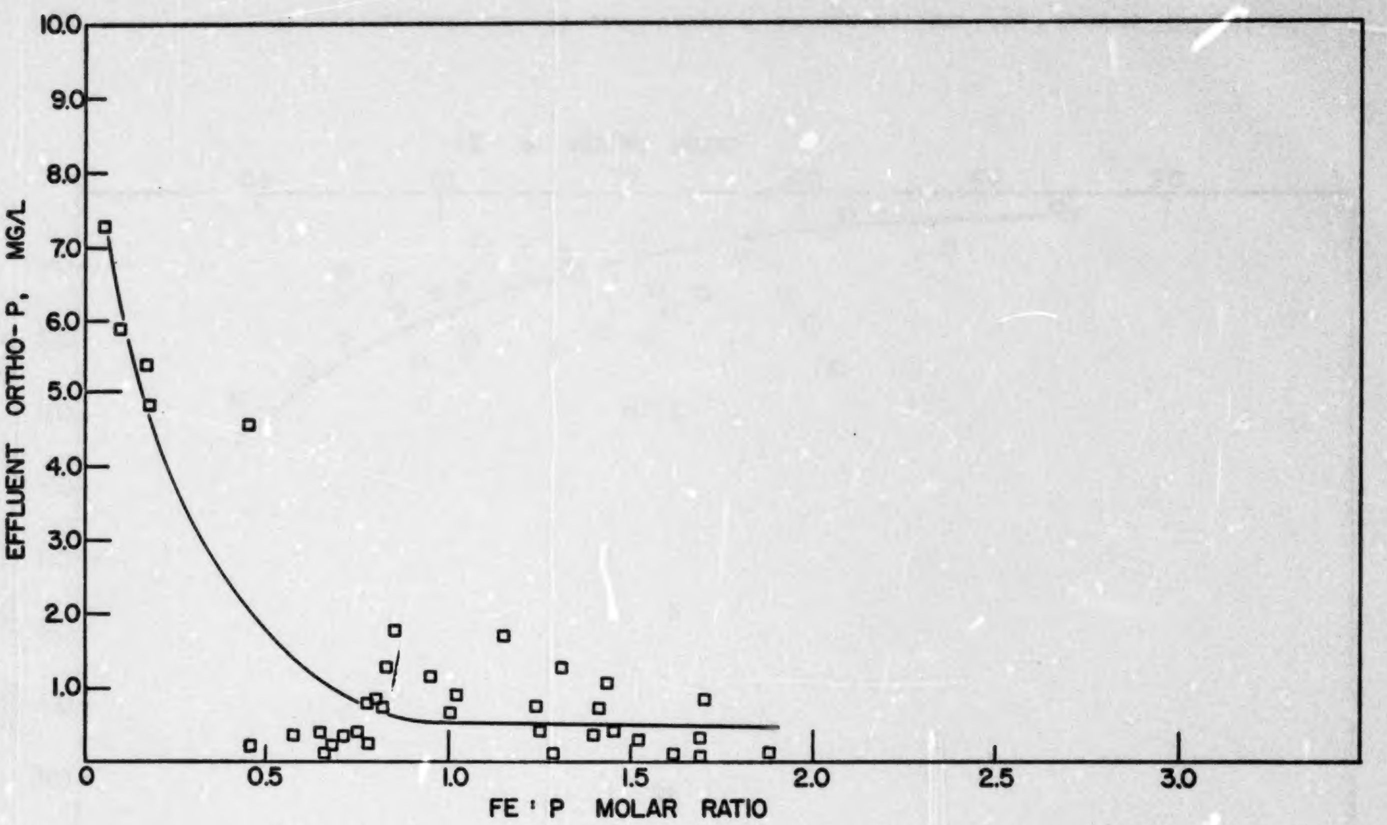

Figure 10. Effect of iron salt on effluent ortho-P concentration (feed after RBC units).

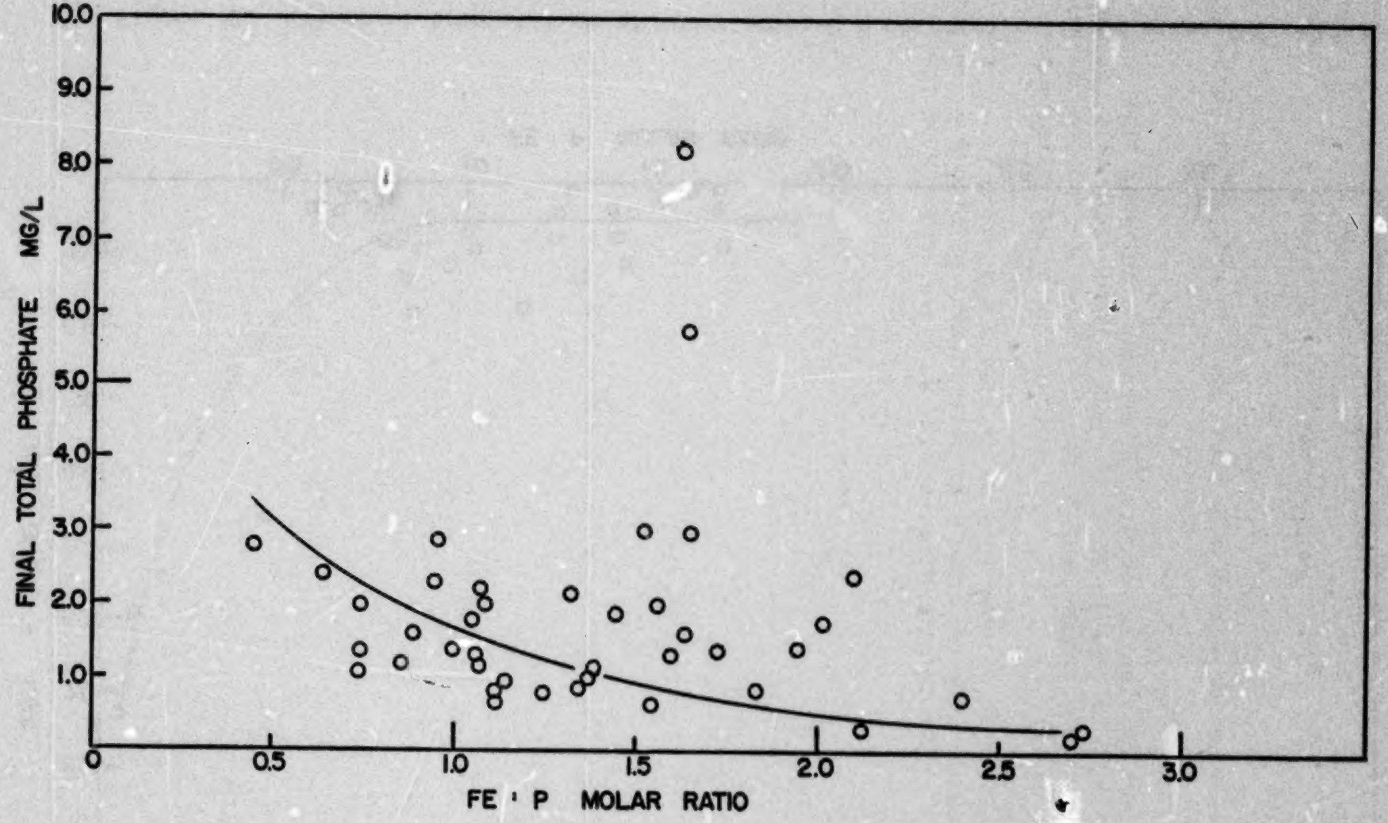

Figure 11. Effect of iron salt on effluent total P concentration (feed before RBC units).

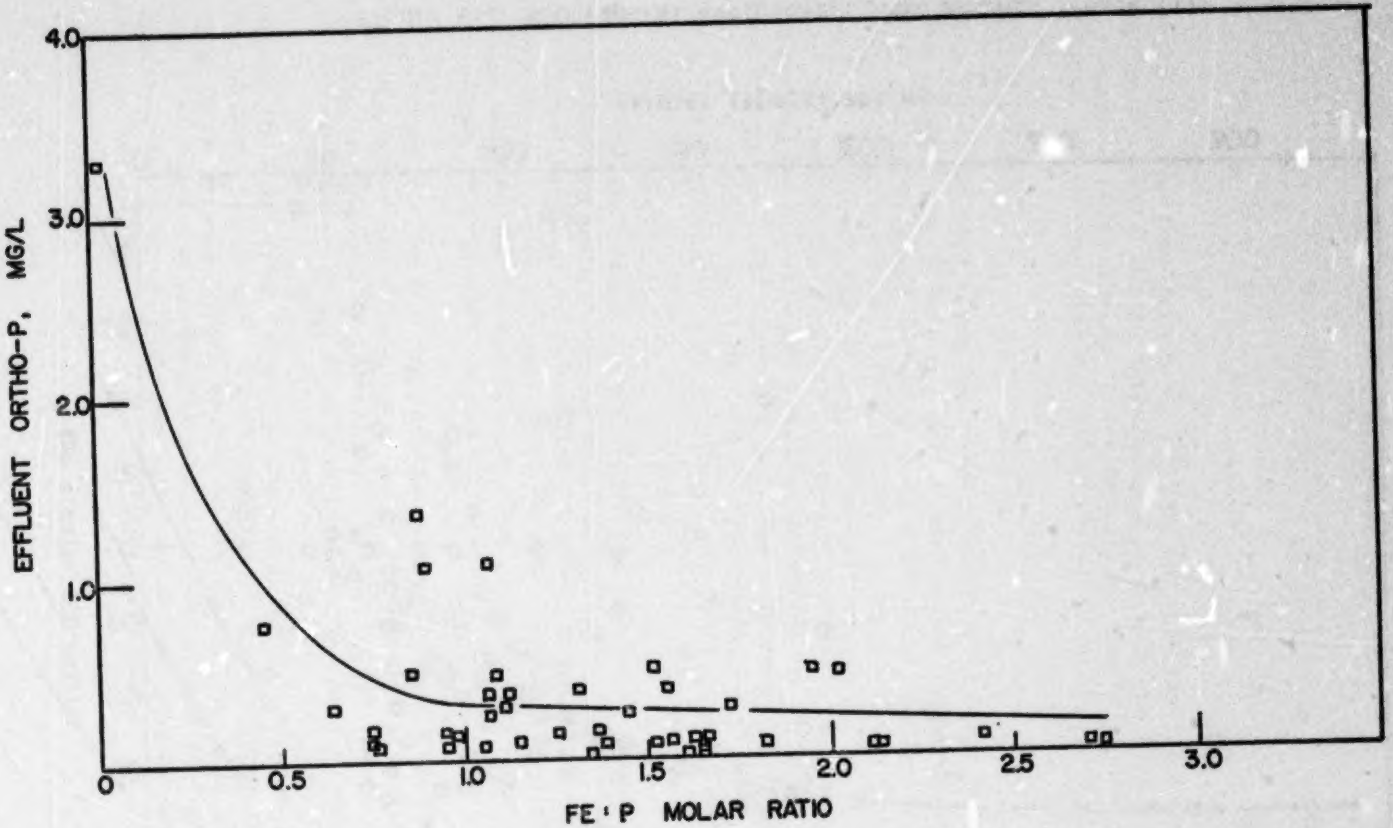

Figure 12. Effect of iron salt on effluent ortho-P concentration (feed before RBC units).

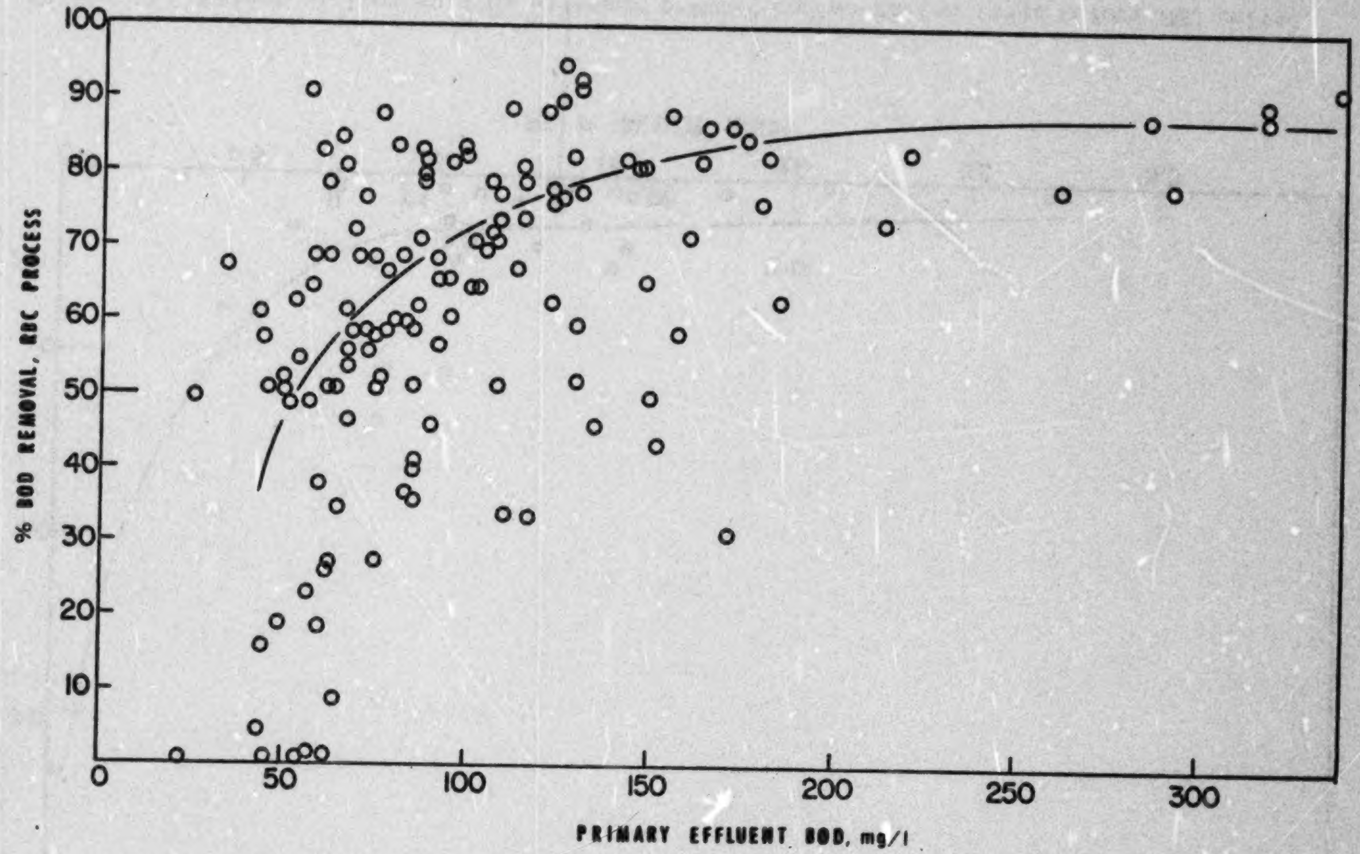

Figure 13. BOD removal efficiency: RBC process (Phase II).

instead of through the oxygen demanding tests. The effect of influent TOC concentration on RBC process removal efficiency is presented in Figure 14. The pattern presented in this plot verifies the previous observation of variable and poor organic removal efficiencies, particularly at, but not limited to, lower organic loadings.

Summary -- A summary of organic removal data for the Phase II test period is presented in Table 11. It is significant to note the close agreement in average BOD, COD and TOC percent removals for both total plant (i.e. 77, 80 and 78 percent) and RBC process performance (i.e. 63, 64 and 65 percent).

Nitrification--

A detailed study of the fate of nitrogen was undertaken during the period from June to December. The variation of effluent nitrate-nitrogen and ammonia-nitrogen are presented in Figures 15 and 16, respectively. It can be seen from Figure 15 that variable nitrification occurred during the six-month period of observation, with relatively high nitrate-nitrogen levels occurring during the month of September. Corresponding ammonia-nitrogen data indicate that complete nitrification did not occur, however, as significant effluent ammonia-nitrogen values are observed in Figure 16.

Effluent Summary--

A summary of final effluent data achieved during the Phase II test period is presented in Table 12. When comparing these data to Phase I data for the RBC process, it is evident that some significant changes occurred. Average effluent values of 35 mg/l BOD, 56 mg/l SS, and 3 mg/l total P were achieved during Phase II, compared to 20 mg/l BOD, 15 mg/l SS and 7 mg/l total P during Phase I.

It can generally be stated that, although improvement was noted in total P removals, the net effect of mineral addition to the RBC process was a deterioration in effluent quality.

ADDITIONAL PLANT DATA

Summaries of treatment plant performance during the interim between Phase I and Phase II (1973 and 1974) and for the year following Phase II (1976) are presented in Appendices H and I. Appendix H summarizes trickling filter operating data for those periods and Appendix I summarizes RBC operating data.

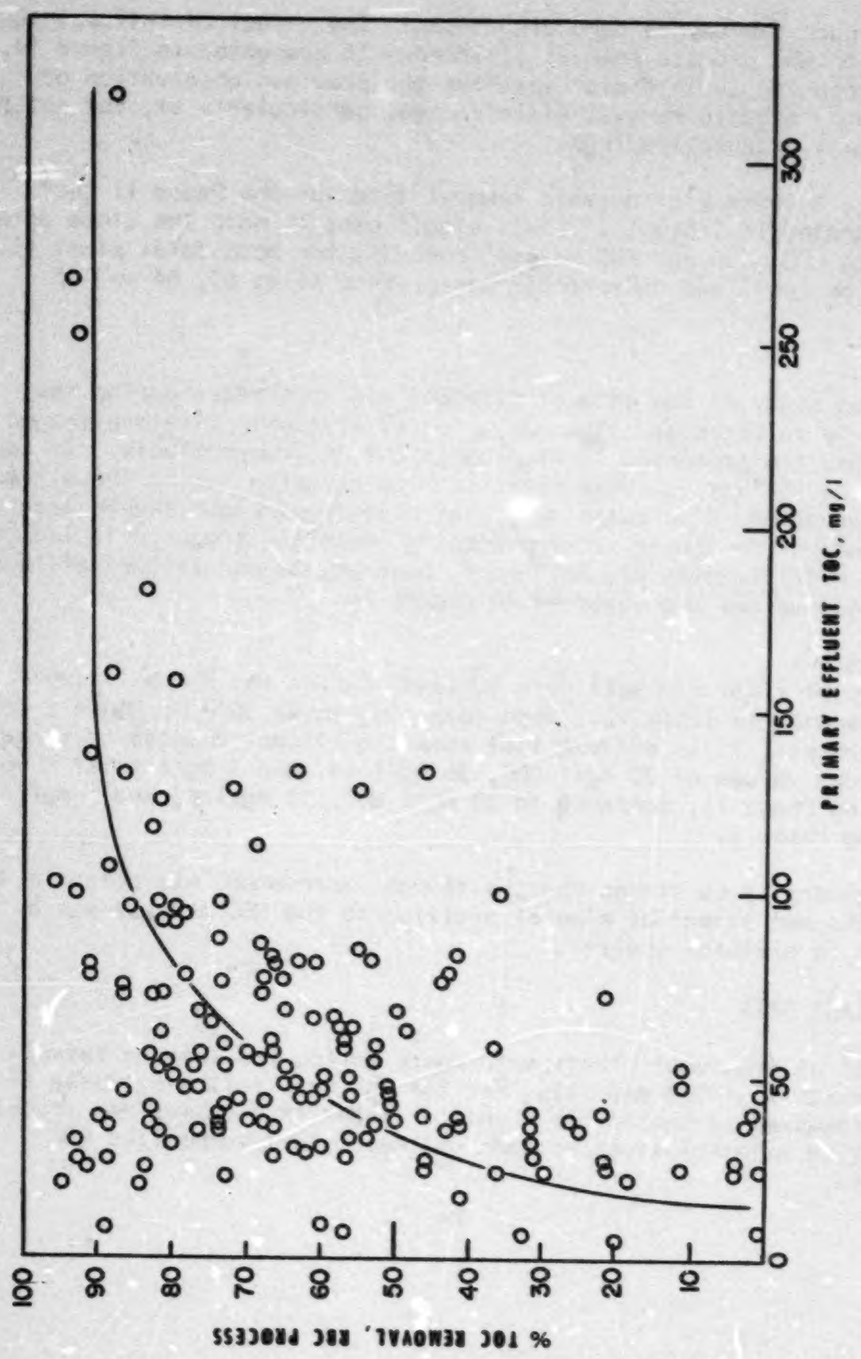

Figure 14. TOC removal efficiency: RBC process (Phase II).

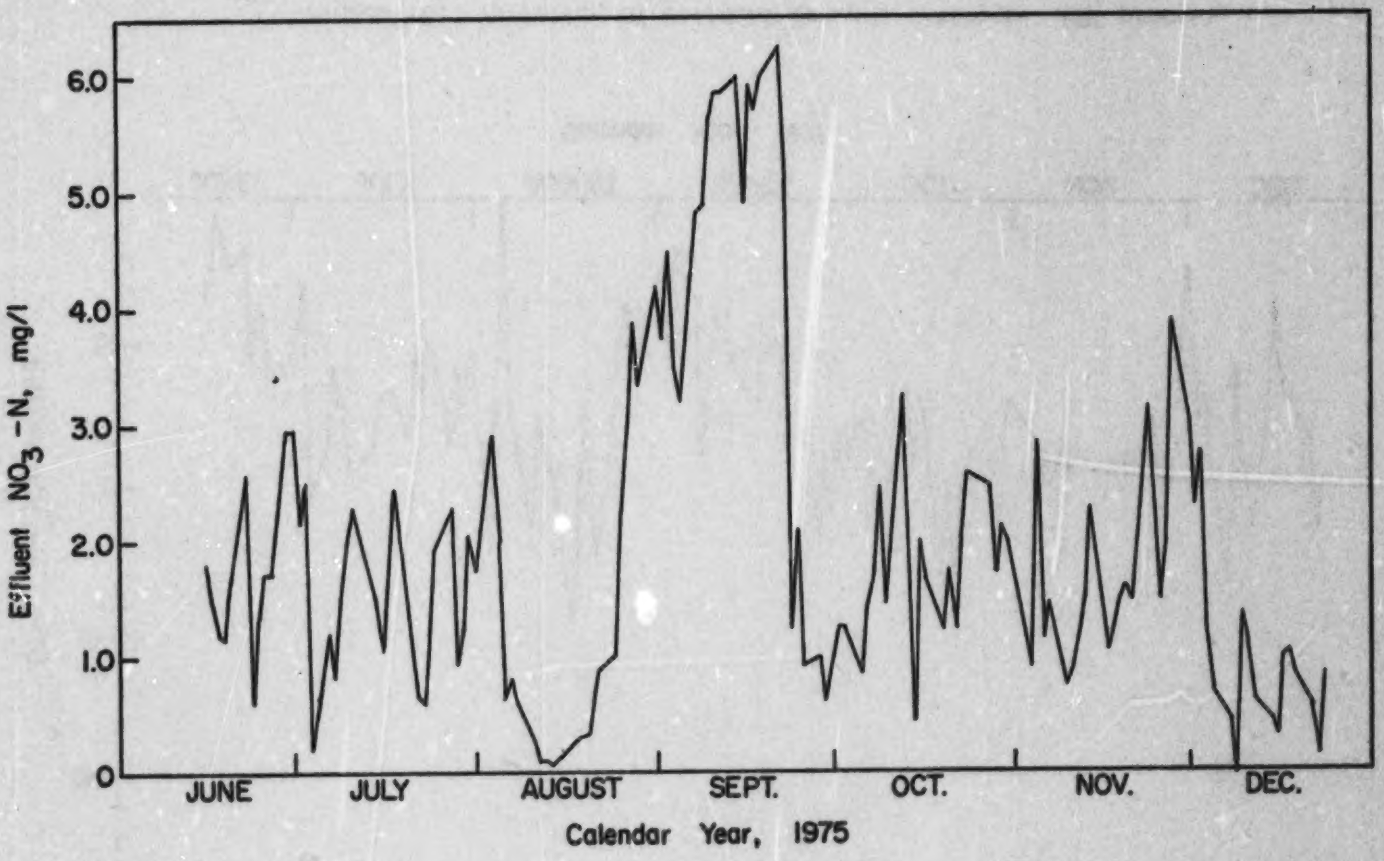

Figure 15. Variation of effluent nitrate nitrogen: RBC process.

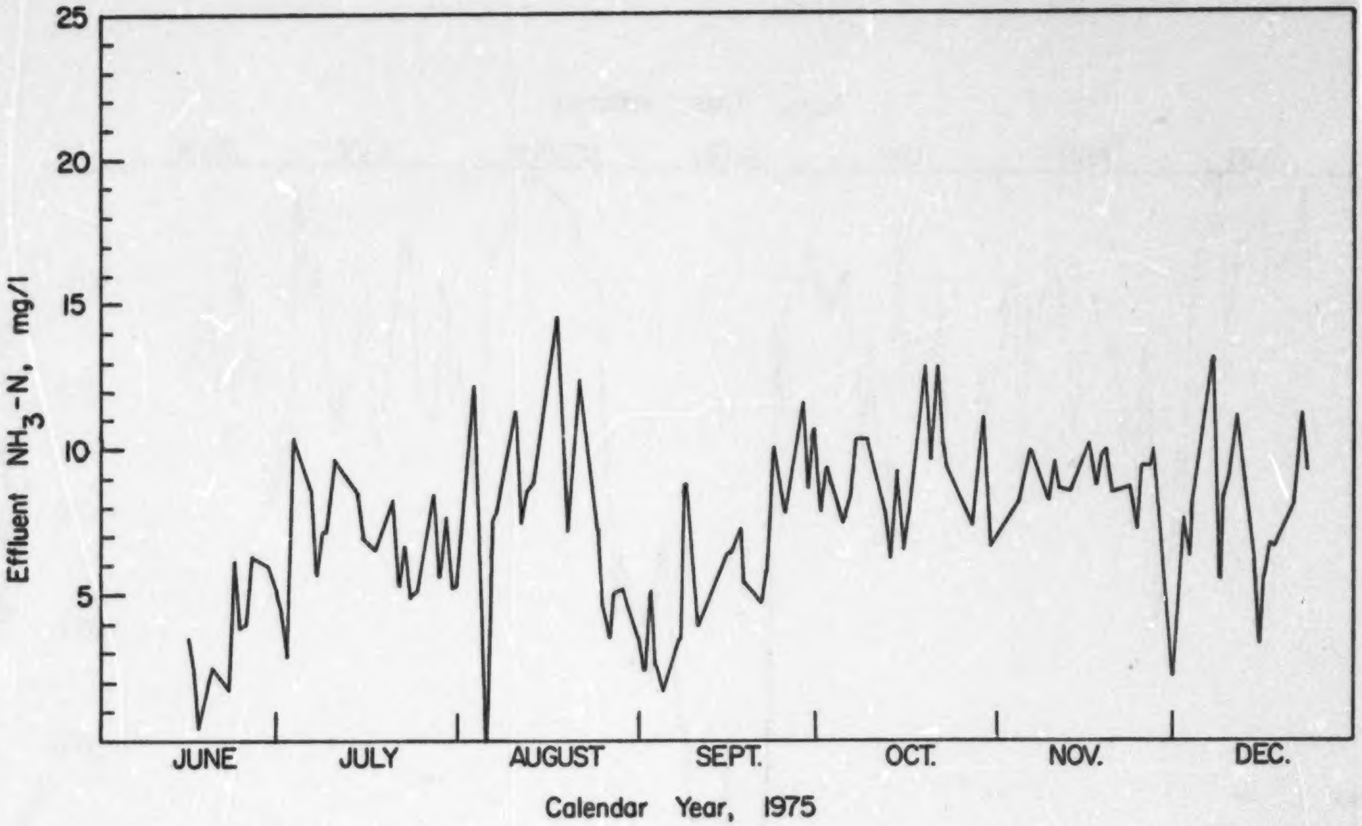

Figure 16. Variation of effluent ammonia nitrogen: RBC process.

TABLE 11. ORGANIC REMOVAL SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, PHASE 11, 1975

Month	Chemical Feed Conditions	Avg. Organic Loading kg Prim. BOD/day/1000 m^2	Avg. Hydraulic Loading m^3/day/1000 m^2	Average Percent Removals BOD Total	BOD RBC	COD Total	COD RBC	TOC Total	TOC RBC
JAN.	Al after discs	8.83	68.46	86	69	92	77	--	--
FEB.	Al after discs	6.10	61.53	83	72	84	74	--	--
MAR.	Al after discs	8.59	106.36	68	49	68	51	71	61
APR.	Al after discs	7.32	110.43	63	57	68	64	52	53
MAY	Al after discs (1-6) Al before discs (12-29)	8.98	129.18	71	64	77	67	76	61
JUNE	Al before discs	6.98	98.21	59	42	64	47	73	57
JULY	Al before discs	6.39	96.58	74	40	81	53	82	49
AUG.	Al after discs (enhanced mixing)	6.20	80.28	76	52	79	44	83	59
SEPT.	Fe after discs	6.78	52.16	85	68	86	67	85	75
OCT.	Fe after discs	6.88	52.98	91	77	92	72	90	72
NOV.	Fe before discs	12.05	58.68	87	76	87	78	90	78
DEC.	Fe before discs	76.91	61.94	81	85	81	79	76	87
AVG.		12.20	81.50	77	63	80	64	78	65

TABLE 12. FINAL EFFLUENT SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, PHASE II, 1975

	Chemical	MONTHLY AVERAGES, mg/l										
Month	Feed Conditions	BOD	COD	TOC	Total P	Ortho P	SS	NO_3-N	NH_3-N	TKN	Al	Fe
JAN.	Al after discs	38	49	--	2.65	1.67	33	4.0	--	--	0.12	--
FEB.	Al after discs	27	65	--	2.35	0.52	46	3.4	--	--	1.09	--
MAR.	Al after discs	40	88	22	3.05	0.46	68	1.2	--	--	1.33	--
APR.	Al after discs	27	57	24	2.40	0.67	44	3.6	--	--	1.53	--
MAY	Al after discs (1-6) Al before discs (12-29)	22	52	9	1.82	0.62	27	3.3	--	--	1.26	--
JUNE	Al before discs	37	83	30	2.51	1.24	47	1.7	--	--	0.64	--
JULY	Al before discs	39	72	19	4.07	2.69	39	1.5	6.7	10.1	0.62	--
AUG.	Al after discs (enhanced mixing)	34	79	13	4.44	2.35	40	1.3	8.2	10.4	0.96	--
SEPT.	Fe after discs	33	59	20	3.85	2.77	36	4.0	6.3	8.6	--	2.3
OCT.	Fe after discs	32	83	21	1.97	0.67	38	1.8	9.0	11.0	--	6.0
NOV.	Fe before discs	43	72	25	1.86	0.53	58	1.8	8.7	11.7	--	4.0
DEC.	Fe before discs	49	102	88	4.78	0.22	190	0.9	7.8	17.4	--	14.5
AVG.		35	78	27	2.98	1.20	56	2.4	7.8	11.5	0.94	6.7

APPENDIX A

TABLE A-1. DESIGN DATA, RBC PLANT

1. Design factors

Avg. daily flow = 1779 m^3/day (470,000 gpd)
Avg. influent BOD = 239 mg/l
Avg. influent S.S. = 363 mg/l
Avg. volatile solids = 277 mg/l
Max. design flow = 4360 m^3/day (48,000 gph)

2. Unit design

a. Primary Clarifier: the primary clarifier consists of the outer annular tank of a concentric "Donau" type clarifier.

Weir loading = 124.2 m^3/day/m (10,000 gpd/ft.)
Surface area = 77.5 m^2 (834 sq. ft.)
Overflow rate, avg. = 22.6 m^3/day/m^2 (554 gpd/sq. ft.)
Volume = 165.4 m^3 (43,700 gal)
Avg. detention time = 1.5 hrs.

b. RBC Units: two parallel paths of 4 stages each are provided; each stage having 150 discs.

Total no. of discs = 1200
Total disc area = 16,945 m^2 (182,400 sq. ft.)
Organic loading = 17.5 g BOD/day/m^2
(3.59 lb. BOD/1000 sq. ft./day)
Hydraulic loading = 7.8 m^3/stage (2062 gal./stage)
Avg. detention time = 42.2 min.
= 10.5 min./stage

c. Secondary Clarifier: center tank of the "Donau" clarifier.

Weir length = 33.2 m (109 ft.)
Weir loading = 53.5 m^3/day/m (4310 gpd/ft.)
Surface area = 86.8 m^2 (934 sq. ft.)
Overflow rate, avg. = 20.5 m^3/day/m^2 (503 gpd/sq. ft.)
Volume = 163.9 m^3 (43,300 gal.)
Detention time = 1.5 hrs.

d. Chlorine Contact Chamber

Capacity = 45.4 m^3 (12,000 gal.)
Contact time = 15 min. (at max. pumping rate)
Chlorine demand = 8 mg/l
Chlorine dosage = 13.9 kg/day (30.6 lbs./day)

e. Aerobic Digester

Volume of primary sludge = 0.2 m^3/hr (52.5 gph)
(re. 30% SS removal, 4% solids)

(continued)

TABLE A-I (continued)

Volume of secondary sludge = 0.3 m^3/hr (84.7 gph)
(re. 86.2% BOD removal,
50% conversion to solids,
2% solids concentration)

Total sludge volume = 0.5 m^3/hr (137.2 gph)
= 9.5 m^3/day (2500 gpd)

Digester volume
(4.75 m diam. x 3.66 m liquid depth) = 275.4 m^3 (72,750 gal.)

Avg. detention time = 28.5 days

Oxygen requirement = 635 kg O_2/day
(1400 lb. O_2/day)
(re. 1.5 kg O_2/kg raw BOD) = 26.4 kg O_2/hr
(58.3 lb. O_2/hr)

Aerator capacity (at 45 rpm) = 31.0 kg O_2/hr
(68.4 lb. O_2/hr)

f. Sludge Beds

No. of sludge beds = 4

Area of each sludge bed = 125.4 m^2 (1350 sq. ft.)
(re. 7.6 m x 16.5 m each)

Total sludge bed area = 501.6 m^2 (5400 sq. ft.)

APPENDIX B

TABLE B-1. DESIGN DATA, TRICKLING FILTER PLANT

1. Design Factors

Avg. daily flow = 1136 m^3/day (300,000 gpd)

Raw wastewater pumps = 3 @ 2180 m^3/day (400 gpm) each

2. Unit Design

a. Primary Clarifier: 13.1 m (43 ft.) × 3.7 m (12 ft.) × 2.8 m (9.25 ft.) depth S.W.D. = 2.4 m (7.75 ft.)

Surface area = 47.9 m^2 (516 sq. ft.)

Overflow rate, avg. = 23.6 m^3/day/m^2 (580 gpd/sq. ft.)

Volume = 113.6 m^3 (30,000 gal.)

b. Trickling Filter: 21.3 m (70 ft.) diam. × 1.7 m (5.7 ft.) depth (stone media, equipped with fiberglass cover)

Surface area = 357.5 m^2 (3848 sq. ft.)
= 0.0357 ha (0.0883 acres)

Volume = 621.2 m^3 (21,936 cu. ft.)

c. Secondary Clarifier: 13.1 m (43 ft.) × 3.7 m (12 ft.) × 2.8 m (9.25 ft.) depth S.W.D. = 2.4 m (7.75 ft.)

(i.e. Design identical to primary clarifier.)

APPENDIX C

TABLE C-1. PHOSPHORUS DATA, PHASE I, JANUARY - JUNE, 1972, RBC PLANT

	PHOSPHORUS CONCENTRATIONS, mg/l									PER CENT REMOVAL	
	Raw Wastewater			Primary Effluent			Final Effluent			Total P	
Date	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Overall	R.B.C.
1-11	11.3	9.6	3.7	9.4	7.9	6.1	8.2	7.9	6.9	27.4	12.8
21	10.7	8.2	3.6	7.8	6.5	4.8	6.7	6.5	5.4	37.4	14.1
28	18.4	7.7	6.4	8.4	6.7	4.8	6.8	6.5	5.5	63.0	19.0
2- 5	10.0	8.0	3.7	9.3	7.8	6.2	7.7	7.6	6.6	23.0	17.2
10	10.4	8.2	3.4	11.0	9.4	5.7	9.4	9.0	5.8	9.6	14.5
18	6.5	4.7	2.4	10.3	9.4	5.1	8.2	7.9	6.0	0.0	20.4
25	8.8	6.3	2.8	10.7	8.6	5.8	9.0	8.6	6.2	0.0	15.9
3- 3	10.8	8.3	4.5	10.7	8.3	6.4	9.2	8.2	6.4	14.8	14.0
10	7.5	--	--	6.5	--	--	4.2	--	--	44.0	35.4
30	7.4	6.8	3.4	9.4	6.8	6.1	6.2	5.9	4.8	16.2	34.0
4- 5	8.3	6.1	2.9	8.1	6.9	5.8	4.7	5.4	4.9	43.4	42.0
13	8.1	4.2	2.5	10.5	6.0	4.4	10.3	5.8	4.9	0.0	1.9
18	7.2	5.3	2.8	9.0	7.1	4.9	7.6	7.2	5.5	0.0	15.6
20	9.3	6.7	2.9	8.2	6.4	4.6	6.9	6.4	5.0	25.8	15.9
25	7.6	6.4	2.8	8.4	7.1	4.3	8.3	7.5	4.8	0.0	1.2
27	9.3	7.3	3.2	8.1	6.6	4.5	6.9	6.7	5.2	25.8	14.8
5- 2	6.9	4.4	2.8	6.4	5.2	3.2	6.0	5.4	4.1	13.0	6.3
4	6.1	4.9	1.5	6.7	5.5	1.9	4.5	4.3	2.9	26.2	32.8
11	8.1	6.5	2.6	8.1	6.6	4.2	6.4	6.4	4.3	21.0	21.0
16	11.2	9.0	3.5	8.8	7.4	5.5	7.8	7.6	5.1	30.6	11.4
18	8.7	7.2	3.1	8.5	7.0	5.3	7.1	6.7	5.2	18.4	16.5
23	16.7	13.9	7.5	11.7	9.8	7.1	9.6	9.2	7.3	42.5	17.9
25	9.8	7.8	3.1	10.2	8.3	5.9	8.3	7.8	5.9	15.3	18.6
6- 6	8.8	7.4	3.8	9.8	8.1	4.8	8.2	7.9	6.7	6.8	16.3
8	10.1	7.9	5.0	11.1	8.6	6.4	8.1	7.6	6.6	19.8	27.0
13	6.1	4.0	2.8	7.9	6.7	3.8	6.8	6.4	5.1	0.0	13.9
15	5.3	4.0	2.4	5.7	4.6	3.1	5.4	5.1	4.2	0.0	5.3
21	11.7	9.8	4.7	8.6	7.2	4.3	7.8	7.4	6.2	33.3	9.3
23	9.7	8.0	4.3	8.7	7.3	5.6	8.0	7.4	5.6	17.5	8.0
27	10.9	8.7	4.9	--	--	--	9.2	8.6	6.9	15.6	--
29	8.3	6.4	4.0	9.1	7.6	6.1	7.6	7.3	5.7	8.4	16.5

TABLE C-2. PHOSPHORUS DATA, PHASE I, JULY - SEPTEMBER, 1972, RBC PLANT

	PHOSPHORUS CONCENTRATIONS, mg/l									PER CENT REMOVAL	
	Raw Wastewater			Primary Effluent			Final Effluent			Total P	
Date	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Overall	R.B.C.
7- 6	10.8	10.8	8.0	9.1	7.8	6.6	8.1	7.7	6.4	25.0	11.0
11	11.0	1.0	6.0	10.1	8.8	6.9	8.4	8.3	6.9	23.6	16.8
13	--	--	--	7.4	6.0	4.1	6.4	6.1	5.3	--	13.5
18	10.3	8.4	5.0	7.1	6.0	3.8	6.7	6.1	5.4	35.0	5.6
20	--	--	--	7.1	5.8	3.9	6.0	5.6	4.7	--	15.5
25	9.5	8.0	5.1	11.3	8.9	6.3	8.6	8.3	7.2	9.5	23.9
27	6.7	7.1	3.4	9.3	4.4	4.8	7.0	6.7	5.5	0.0	24.7
31	11.2	9.0	7.2	11.1	9.6	6.6	8.7	8.6	7.4	22.3	21.6
8- 8	--	--	--	10.1	7.5	5.7	7.8	7.5	6.3	--	22.8
10	7.8	7.8	4.3	11.2	6.8	5.7	7.4	7.0	6.3	5.1	33.9
15	8.7	7.4	2.6	9.0	6.9	5.0	--	--	--	--	--
17	4.5	3.4	2.3	6.9	5.4	4.5	6.2	6.0	5.5	0.0	10.1
22	12.6	9.5	6.4	10.0	8.1	4.5	6.1	5.9	3.7	51.6	39.0
24	6.9	5.3	3.4	7.9	7.9	4.2	5.9	5.9	4.2	14.5	12.7
29	12.1	10.2	3.5	9.2	6.2	4.5	7.0	6.4	5.3	42.1	23.9
31	4.3	3.0	1.8	9.3	5.9	3.9	6.3	5.9	4.8	0.0	32.3
9- 7	10.7	8.8	4.6	10.1	7.0	5.3	8.1	7.6	5.9	24.3	19.8
12	16.2	13.5	4.5	10.8	8.9	6.5	9.1	8.7	7.4	43.8	15.7
14	4.9	3.4	2.6	7.5	5.6	4.5	6.2	5.8	5.2	0.0	17.3
19	3.0	2.4	1.5	4.6	2.0	1.2	3.1	2.1	1.3	0.0	32.6
21	3.8	3.1	1.2	16.9	3.1	2.6	4.2	3.3	2.6	0.0	75.1
26	7.5	6.1	2.7	6.9	4.5	3.4	5.5	4.6	3.6	26.7	20.3
28	5.2	4.2	2.1	5.3	4.0	2.5	2.4	2.1	1.9	53.8	54.7

TABLE C-3. PHOSPHORUS DATA, PHASE I, OCTOBER - DECEMBER, 1972, RBC PLANT

	PHOSPHORUS CONCENTRATIONS, mg/l									PER CENT REMOVAL	
	Raw Wastewater			Primary Effluent			Final Effluent			Total P	
Date	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Overall	R.B.C.
10- 3	5.1	4.0	2.8	6.6	5.3	3.2	5.7	5.2	4.2	0.0	13.6
5	3.1	2.4	1.5	6.4	4.6	3.2	4.8	4.4	3.4	0.0	25.0
10	6.0	4.8	3.1	9.7	8.3	4.2	6.8	6.4	5.0	0.0	30.0
12	--	--	--	6.8	5.4	3.6	5.6	5.2	4.2	--	17.6
17	4.4	3.6	2.1	8.4	6.4	3.4	6.8	6.0	4.6	0.0	19.0
19	5.3	4.0	2.2	7.0	5.5	3.4	6.0	5.8	4.4	0.0	14.3
24	3.6	3.0	1.4	5.1	3.9	1.8	4.2	3.7	2.7	0.0	17.6
26	3.3	2.4	1.8	4.8	3.6	2.1	3.8	3.6	2.5	0.0	20.8
31	9.7	8.2	3.1	7.1	5.6	3.0	5.7	5.4	4.0	41.2	19.7
11- 2	4.0	2.9	1.6	5.8	4.6	2.8	4.7	4.4	3.6	0.0	19.0
7	7.6	6.4	3.2	8.1	6.5	3.6	6.3	6.0	4.7	17.1	22.2
9	7.8	6.4	2.9	7.0	5.7	3.6	5.6	5.2	4.2	23.1	20.0
14	6.0	4.7	2.4	8.3	7.0	4.2	7.4	7.0	5.4	0.0	10.8
16	6.2	5.0	2.8	7.8	5.8	3.5	6.0	5.6	3.8	3.2	23.1
12- 5	7.9	6.0	4.1	10.0	8.5	6.7	9.5	9.1	7.3	0.0	5.0
7	4.7	3.5	2.9	8.7	7.2	5.2	6.6	6.3	5.2	0.0	24.1
19	8.6	7.2	4.1	12.2	10.1	7.3	8.7	8.3	7.2	0.0	28.7
Avg. (Entire Year)	8.1	6.4	3.4	8.6	6.7	4.6	6.9	6.5	5.1	14.9	20.6

APPENDIX D

TABLE D-1. PHOSPHORUS DATA, PHASE I, JANUARY - JUNE, 1972, TRICKLING FILTER

	PHOSPHORUS CONCENTRATIONS, mg/l									PER CENT REMOVAL	
	Raw Wastewater			Primary Effluent			Final Effluent			Total P	
Date	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Overall	T.F.
1-11	11.3	9.6	3.7	12.1	9.2	7.1	9.5	8.0	6.3	15.9	21.5
21	10.7	8.2	3.6	10.4	7.9	5.7	8.5	7.2	5.6	20.6	18.3
28	18.4	7.7	6.4	10.0	7.5	5.9	8.5	7.0	5.8	53.8	15.0
2- 5	10.0	8.0	3.7	9.4	7.1	6.0	8.4	7.3	5.8	16.0	10.6
10	10.4	8.2	3.4	11.4	9.2	6.4	10.8	9.4	6.6	0.0	5.3
18	6.5	4.7	2.4	11.3	8.7	5.8	10.7	9.2	7.0	0.0	5.3
25	8.8	6.3	2.8	11.5	8.5	6.1	10.1	9.1	6.3	0.0	12.2
3- 3	10.8	8.3	4.5	9.4	7.4	7.1	7.7	4.7	4.7	28.7	18.1
10	7.5	--	--	7.4	--	--	5.9	--	--	21.3	20.3
30	7.4	6.8	3.4	7.9	5.6	5.6	6.8	4.4	4.4	8.1	13.9
4- 5	8.3	6.1	2.9	8.4	6.1	4.3	7.5	7.5	4.6	9.6	10.7
13	8.1	4.2	2.5	12.6	5.9	3.7	7.8	5.6	4.3	3.7	38.1
18	7.2	5.3	2.8	10.5	7.5	4.9	9.1	7.2	5.3	0.0	13.3
20	9.3	6.7	2.9	9.7	7.1	4.3	--	--	--	--	--
25	7.6	6.4	2.8	9.1	7.4	3.7	7.9	6.6	4.5	0.0	13.2
27	9.3	7.3	3.2	9.0	7.0	4.9	7.9	6.7	4.6	15.1	12.2
5- 2	6.9	4.4	2.8	--	--	--	7.3	6.2	4.1	0.0	--
4	6.1	4.9	1.5	8.3	5.7	3.1	7.1	5.6	2.7	0.0	14.5
11	8.1	6.5	2.6	9.4	6.2	4.4	7.1	6.0	4.5	12.3	24.5
16	11.2	9.0	3.5	10.6	7.7	4.9	9.6	8.1	5.3	14.3	9.9
18	8.7	7.2	3.1	9.4	7.0	5.2	7.8	6.5	4.3	10.3	17.0
23	16.7	13.9	7.5	12.9	10.4	7.4	11.2	9.8	6.5	32.9	13.2
25	9.8	7.8	3.1	10.2	7.8	5.7	9.1	7.8	5.6	7.1	10.8
6- 6	8.8	7.4	3.8	11.6	7.9	5.3	9.3	7.1	4.9	0.0	19.8
8	10.1	7.9	5.0	11.0	7.6	5.1	8.9	6.9	4.8	11.9	19.1
13	6.1	4.0	2.8	8.4	5.7	3.6	8.8	6.6	4.8	0.0	0.0
15	5.3	4.0	2.4	6.6	4.5	2.9	6.2	4.7	3.3	0.0	6.1
21	11.7	9.8	4.7	9.4	6.8	4.1	9.0	7.2	4.8	23.1	4.3
23	9.7	8.0	4.3	10.2	7.3	4.5	9.4	7.3	4.9	3.1	7.8
27	10.9	8.7	4.9	10.8	8.1	5.2	10.2	8.5	6.4	6.4	5.6
29	8.3	6.4	4.0	10.3	7.7	5.0	9.1	8.0	5.7	0.0	11.6

TABLE D-2. PHOSPHORUS DATA, PHASE I, JULY - SEPTEMBER, 1972, TRICKLING FILTER

	PHOSPHORUS CONCENTRATIONS, mg/l									PER CENT REMOVAL	
	Raw Wastewater			Primary Effluent			Final Effluent			Total P	
Date	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Overall	T.F.
7- 6	10.8	10.8	8.0	13.4	13.4	7.5	9.4	8.0	6.5	13.0	30.0
11	11.0	1.0	6.0	12.7	9.9	7.4	11.0	9.8	7.9	0.0	13.4
13	--	--	--	11.7	8.8	6.8	10.3	9.1	7.1	--	12.0
18	10.3	8.4	5.0	15.7	8.5	7.5	6.8	6.5	5.4	34.0	56.7
20	--	--	--	12.3	7.3	6.5	6.0	5.6	4.8	--	51.2
25	9.5	8.0	5.1	66.0	18.0	16.0	9.0	8.4	7.0	5.3	86.4
27	6.7	7.1	3.4	53.0	16.0	12.0	7.6	6.9	5.6	0.0	85.7
31	11.2	9.0	7.2	18.5	7.0	7.5	9.5	8.5	7.0	15.2	48.6
8- 8	--	--	--	7.3	4.1	3.0	7.7	7.0	5.3	--	0.0
10	7.8	7.8	4.3	8.8	8.8	4.6	7.3	6.8	5.6	6.4	17.0
15	8.7	7.4	2.6	8.9	6.8	4.2	7.6	6.9	5.0	12.6	14.6
17	4.5	3.4	2.3	7.4	5.2	4.0	6.2	5.6	4.7	0.0	16.2
22	12.6	9.5	6.4	8.8	5.0	4.5	7.8	6.9	4.6	38.1	11.4
24	6.9	5.3	3.4	7.3	5.8	4.6	5.6	5.6	4.2	18.8	23.3
29	12.1	10.2	3.5	7.3	5.3	3.1	6.6	5.8	4.3	45.5	9.6
31	4.3	3.0	1.8	6.8	4.8	3.5	6.6	5.8	4.5	0.0	2.9
9- 7	10.7	8.8	4.6	--	--	--	--	--	--	--	--
12	16.2	13.5	4.5	8.3	6.3	4.4	8.6	7.5	5.3	46.9	0.0
14	4.9	3.4	2.6	6.3	4.8	2.8	5.5	4.7	3.6	0.0	12.7
19	3.0	2.4	1.5	3.5	2.4	1.1	3.3	2.6	1.9	0.0	5.7
21	3.8	3.1	1.2	5.0	3.3	1.8	3.7	3.0	2.0	2.6	26.0
26	7.5	6.1	2.7	6.4	3.9	2.4	4.4	4.0	2.9	41.3	31.3
28	5.2	4.2	2.1	4.4	3.4	1.9	4.4	3.4	2.5	15.4	0.0

TABLE D-3. PHOSPHORUS DATA, PHASE I, OCTOBER - DECEMBER, 1972, TRICKLING FILTER

	PHOSPHORUS CONCENTRATIONS, mg/l									PER CENT REMOVAL	
	Raw Wastewater			Primary Effluent			Final Effluent			Total P	
Date	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Total	Filtrable	Ortho	Overall	T.F.
10- 3	5.1	4.0	2.8	5.0	4.1	2.4	5.3	4.6	3.1	0.0	0.0
5	3.1	2.4	1.5	5.0	4.0	2.3	4.8	4.2	3.0	0.0	4.0
10	6.0	4.8	3.1	7.3	6.1	3.8	7.0	6.2	4.4	0.0	4.1
12	--	--	--	5.4	4.0	2.8	5.3	4.6	3.6	--	0.0
17	4.4	3.6	2.1	7.6	6.2	4.1	7.1	6.7	4.7	0.0	6.6
19	5.3	4.0	2.2	9.2	6.3	4.2	7.4	6.1	4.4	0.0	19.6
24	3.6	3.0	1.4	4.1	3.2	1.9	4.7	3.9	2.9	0.0	0.0
26	3.3	2.4	1.8	4.4	3.6	1.9	4.3	3.5	2.6	0.0	2.3
31	9.7	8.2	3.1	6.1	5.0	2.9	6.6	5.6	3.6	32.0	0.0
11- 2	4.0	2.9	1.6	6.0	4.8	3.0	6.3	5.3	3.7	0.0	0.0
7	7.6	6.4	3.2	6.7	5.9	4.4	6.9	6.1	4.2	9.2	0.0
9	7.8	6.4	2.9	6.2	5.4	3.2	5.8	5.0	3.8	25.6	6.5
14	6.0	4.7	2.4	7.2	6.2	3.5	6.8	6.2	4.3	0.0	5.6
16	6.2	5.0	2.8	5.8	5.0	3.4	6.1	5.4	4.3	1.6	0.0
12- 5	7.9	6.0	4.1	--	--	--	9.1	7.7	5.8	0.0	--
7	4.7	3.5	2.9	8.5	6.2	4.0	8.2	6.8	5.7	0.0	3.5
19	8.6	7.2	4.1	10.6	7.6	5.8	10.7	9.2	6.0	0.0	0.0
Avg. (Entire Year)	8.1	6.4	3.4	10.4	6.8	4.8	7.6	6.5	4.8	5.8	26.6

APPENDIX E

TABLE E-1. PHOSPHORUS DATA, PEWAUKEE STP, JANUARY 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1				946		
2				1045		
3				973		
4				943		
5		5.66	5.25	954	5.39	5.00
6		5.66	5.50	1064	6.01	5.84
7	1.02	5.00	4.10	1064	5.31	4.35
8	1.36	3.16	4.05	1226	3.87	4.96
9	0.99	3.66	4.50	1843	6.74	8.29
10				2411		
11				1821		
12		1.50	1.60	1332	2.00	2.13
13		1.00	0.38	1685	1.68	0.64
14	2.11	1.16	0.17	1158	1.34	0.20
15	0.75	1.26	0.20	1075	1.35	0.21
16	3.10	1.33	0.12	965	1.28	0.11
17				1011		
18				825		
19	3.41	1.60	0.45	810	1.29	0.36
20	0.52	2.20	1.60	1166	2.56	1.86
21	1.03	2.20	0.42	1011	2.22	0.42
22	1.08	2.80	0.45	1226	3.43	0.55
23	1.25	3.44	0.40	1177	4.05	0.47
24				1351		
25				1552		
26		1.74	0.27	738	1.28	0.20
27		1.50	0.27	871	1.30	0.23
28	0.57	2.90	1.55	1329	3.85	2.05
29	0.72	2.80	1.57	757	2.12	1.18
30	2.69	NS	NS	799		
31				992		
Avg.	1.47	2.65	1.67	1162		

NOTE: ALUM FEED AFTER RBC UNITS

TABLE E-2. PHOSPHORUS DATA, PEWAUKEE STP, FEBRUARY 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1				1170		
2				1166		
3	2.58	2.80	1.65	723	2.02	1.19
4	1.79	2.24	0.72	806	1.80	0.58
5	1.91	2.00	0.40	1052	2.10	0.42
6	2.20	1.50	0.25	1041	1.56	0.26
7				977		
8				1060		
9		2.80	0.70	1166	3.26	0.81
10	1.56	3.20	1.65	939	3.00	1.55
11	2.74	3.94	1.50	878	3.46	1.32
12	3.09	2.10	0.30	878	1.84	0.26
13	3.25	2.30	0.35	867	1.99	0.30
14				1196		
15				1067		
16	1.31	2.60	0.30	1192	3.10	0.35
17	3.46	2.20	0.27	937	2.06	0.25
18	2.72	0.50	0.03	1064	0.53	0.03
19	2.59	1.60	0.15	1128	1.80	0.17
20	2.48	3.40	0.33	1249	4.24	0.41
21				912		
22				1223		
23	1.90	3.14	0.46	1011	3.17	0.46
24	1.94	NS	NS	1162		
25	3.14	2.60	0.11	1219	3.17	0.13
26	2.64	1.60	0.18	1086	1.73	0.20
27	2.34	1.80	0.11	1052	1.89	0.11
28				1011		
Avg.	2.42	2.35	0.52	1045		

NOTE: ALUM FEED AFTER RBC UNITS

TABLE E-3. PHOSPHORUS DATA, PEWAUKEE STP, MARCH 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1				1003		
2	1.84	2.0	0.17	787	1.57	0.14
3	2.46	2.34	0.22	1079	2.52	0.24
4	3.10	1.84	1079	1.98	0.12	
5	2.86	2.24	0.17	988	2.21	0.17
6	2.58	2.40	0.14	1033	2.48	0.14
7				980		
8				590		
9	0.54	3.20	0.10	1223	3.91	0.12
10	1.31	4.00	0.78	1098	2.12	0.86
11	1.80	2.24	0.25	1083	2.42	0.27
12	2.50	2.34	0.16	1048	2.45	0.17
13	2.43	3.20	0.20	939	3.00	0.19
14				958		
15				1185		
16	0.62	4.50	1.18	1340	6.02	1.58
17	0.69	3.00	0.82	1919	5.75	1.57
18	0.93	3.40	0.37	2589	10.09	0.96
19	0.90	2.40	0.35	2755	6.61	0.96
20	1.03	3.06	0.64	3123	9.55	2.00
21				3369		
22				1877		
23	1.23	3.00	0.41	2396	7.18	0.98
24	0.92	3.48	0.59	2975	10.35	1.75
25		3.20	0.64	2559	8.18	1.63
26		3.84	0.69	1900	7.29	1.31
27	1.18	2.60	0.56	1699	4.41	0.95
28				2161		
29				2146		
30	1.10	NS	NS	1821		
31	0.81	3.04	1.18	2566	7.79	3.03
Avg.	1.54	3.05	0.46	1684		

NOTE: ALUM FEED AFTER RBC UNITS

TABLE E-4. PHOSPHORUS DATA, PEWAUKEE STP, APRIL 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1	1.57	3.50	0.57	1930	6.75	1.11
2	1.26	3.16	0.77	1900	6.00	1.46
3	1.28	3.10	0.66	1752	5.43	1.15
4				1677		
5				1620		
6	0.91	2.80	0.74	1552	4.34	1.15
7	1.10	2.60	0.43	1866	8.45	0.80
8	1.50	3.34	0.91	1832	6.11	1.66
9	1.27	2.20	0.57	1715	3.77	0.98
10	1.43	2.90	0.80	1669	4.83	1.43
11				1646		
12				1419		
13	0.85	NS	NS	1317		
14	1.09	1.86	0.48	1469	2.73	0.71
15	1.08	NS	NS	1374		
16	1.21	2.50	0.55	1412	3.52	0.78
17	1.46	2.50	0.81	1336	3.34	1.08
18				1669		
19				1317		
20	1.10	NS	NS	1385		
21	1.36	2.84	0.92	1435	4.07	1.40
22	1.56	2.26	0.68	1382	3.12	0.93
23	1.80	2.10	0.58	1559	3.27	0.90
24	1.84	1.76	0.56	1450	2.55	0.81
25				1370		
26				1215		
27	1.39	2.44	0.61	1582	3.86	0.96
28	1.38	2.72	1.25	1207	3.28	1.51
29	2.05	1.76	0.32	2460	4.33	0.78
30	2.23	1.60	0.33	2112	3.37	0.69
Avg.	1.40	2.40	0.67	1537		

NOTE: ALUM FEED AFTER RBC UNITS

TABLE E-5. PHOSPHORUS DATA, PEWAUKEE STP, MAY 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1	1.80	2.04	0.31	2067	4.21	0.64
2				1930		
3				1681		
4	1.32	1.32	0.15	1639	2.16	0.24
5	1.72	2.56	0.50	1881	4.81	0.94
6	1.95	2.00	0.36	1927	3.85	0.70
7		2.72	1.62	1699		
8		2.20	1.72	1544		
9				1518		
10				1332		
11		1.26	0.39	1404	1.76	0.54
12	1.20	1.82	0.54	1949	3.54	1.05
13	1.38	1.90	0.54	2381	4.52	1.28
14	1.84	1.44	0.38	1911	2.75	0.73
15	2.58	1.44	0.44	1427	2.05	0.63
16				1696		
17				1302		
18	1.70	1.26	0.36	1264	1.59	0.45
19	2.48	2.50	0.55	2267	5.67	1.24
20	1.05	1.72	0.60	2173	3.73	1.30
21	1.18	1.60	0.47	2286	3.65	1.07
22	1.34	1.14	0.36	1832	2.09	0.66
23				2263		
24				1938		
25	0.88	1.10	0.43	1866	2.05	0.81
26		2.66	1.63	2029	5.39	3.30
27	1.55	1.94	0.95	1412	2.74	1.34
28	2.32	1.16	0.36	1018	1.18	0.37
29	3.04	2.54	0.36	1011	2.56	0.37
30				1177		
31				893		
Avg.	1.73	1.83	0.62	1699		

NOTE: ALUM FEED AFTER RBC UNITS MAY 1-6
ALUM FEED BEFORE RBC UNITS MAY 12-29

TABLE E-6. PHOSPHORUS DATA, PEWAUKEE STP, JUNE 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1	0.83	2.06	0.75	893	1.84	0.67
2	2.76	1.82	0.66	1079	1.96	0.71
3	2.05	1.72	0.55	1075	1.85	0.59
4	1.84	2.22	0.56	1400	3.11	0.78
5	1.73	2.44	0.69	1442	3.52	0.99
6				1264		
7				1056		
8	1.16	1.62	0.95	931	1.51	0.88
9	0.91	2.50	0.98	1370	3.42	1.34
10	3.25	2.50	1.00	1041	2.60	1.04
11	2.19	1.58	0.72	1544	2.44	1.12
12	2.57	1.46	0.72	1196	1.74	0.87
13				1139		
14				1400		
15	0.23	2.38	1.45	1522	3.62	2.20
16	0.85	3.80	1.85	1419	5.39	2.62
17	1.33	4.74	1.20	1798	8.51	2.15
18	0.56	3.88	2.00	1582	6.13	3.16
19	0.55	3.48	1.85	1412	4.91	2.61
20				1389		
21				738		
22	1.17	2.04	1.48	939	1.91	1.39
23	1.22	3.08	1.57	1435	4.41	2.25
24	0.74	2.60	1.66	1427	3.71	2.36
25	1.28	2.34	1.62	1355	3.17	2.[illegible]
26	1.17	2.00	1.46	1313	2.62	1.91
27				1329		
28				1117		
29	0.84	2.20	1.73	1048	2.30	1.81
30	1.22	2.80	1.73	1151	3.22	1.99
Avg.	1.38	2.51	1.24	1260		

NOTE: ALUM FEED BEFORE RBC UNITS

TABLE E-7. PHOSPHORUS DATA, PEWAUKEE STP, JULY 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1	1.16	3.32	2.08	1385	4.59	2.88
2	1.22	2.26	1.58	1419	3.20	2.24
3	1.32	6.60	3.10	1253	8.26	3.88
4				1234		
5				1287		
6	0.70	4.32	3.42	1317	5.68	4.50
7	0.98	3.04	2.31	1298	3.94	2.99
8	1.14	2.70	1.72	1291	3.48	2.22
9	0.99	2.90	1.75	1279	3.71	2.24
10	0.68	3.80	1.80	1238	4.70	2.23
11				1347		
12				1113		
13	.43	NS	NS	1086		
14	.94	3.36	2.88	1011	3.39	2.91
15	.77	3.80	2.45	1283	4.87	3.14
16	.84	3.70	2.45	1329	4.91	3.25
17	.70	3.70	2.30	1438	5.32	3.30
18				1563		
19				1264		
20	.40	5.00	2.12	1154	5.77	2.44
21		5.32	2.85	1484	7.89	4.22
22		4.34	2.15	1325	5.74	2.84
23		3.90	1.48	1442	5.62	2.13
24		3.94	1.73	1230	4.84	2.12
25				1120		
26				984		
27		5.00	4.40	920	4.59	4.04
28		4.86	4.20	942	4.58	3.96
29		4.56	4.20	946	4.31	3.97
30		4.20	4.00	946	3.97	3.78
31		5.00	4.10	1086	5.43	4.45
Avg.	0.88	4.07	2.69	1226		

NOTE: ALUM FEED BEFORE RBC UNITS

TABLE E-8. PHOSPHORUS DATA, PEWAUKEE STP, AUGUST 1975

Date	Al/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1				1450		
2				787		
3		4.84	2.23	692	3.35	1.54
4		5.12	2.10	992	5.07	2.08
5	1.24	3.34	0.81	897	2.99	0.73
6	1.19	3.26	0.86	992	3.23	0.85
7	1.75	2.20	0.55	886	1.95	0.49
8				1366		
9				1128		
10	0.38	5.00	2.90	1067	5.33	3.09
11	0.59	5.30	2.95	1450	7.67	4.27
12	0.62	5.60	3.03	1306	7.31	3.95
13	0.72	4.34	2.15	1461	6.34	3.14
14	0.48	4.90	2.70	1018	4.99	2.74
15				829		
16				659		
17	0.68	6.30	5.35	674	4.24	3.60
18	0.86	5.00	2.95	859	4.29	2.53
19	0.89	4.00	2.35	920	3.67	2.16
20	0.98	4.24	2.00	1211	5.13	2.42
21	0.89	4.30	2.21	1230	5.28	2.72
22				1991		
23				1412		
24	0.43	3.70	1.97	1170	4.32	2.30
25	0.66	4.70	2.28	1510	7.09	3.44
26	0.79	4.50	1.95	1374	6.18	2.68
27	0.83	4.42	2.00	1219	5.38	2.44
28	0.77	3.76	1.82	1223	4.59	2.22
29				1211		
30				973		
31		4.48	4.10	871	3.90	3.57
Avg.	0.82	4.44	2.35	1124		

NOTE: ALUM FEED AFTER RBC UNITS WITH ENHANCED MIXING

TABLE E-9. PHOSPHORUS DATA, PEWAUKEE STP, SEPTEMBER 1975

Date	Fe/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1		5.20	4.70	1033	5.37	4.85
2		4.70	3.88	1071	5.03	4.15
3		4.76	4.10	1083	5.15	4.43
4		5.26	4.00	1329	6.98	5.31
5				1752		
6				905		
7	0.79	1.84	0.75	844	1.55	0.63
8	0.83	2.50	1.35	958	2.39	1.29
9	1.47	1.56	0.47	950	1.48	0.44
10	1.41	1.56	0.40	1007	1.57	0.40
11	1.03	1.28	0.90	916	1.17	0.82
12				833		
13				685		
14	0.18	4.00	4.85	685	2.74	3.32
15	0.86	2.86	1.76	848	2.42	1.49
16	1.44	1.90	1.05	768	1.46	0.81
17	0.48	5.12	4.55	749	3.83	3.43
18	0.18	6.24	5.42	749	4.67	4.06
19				715		
20				659		
21	0.05	9.10	7.25	613	5.57	4.44
22	1.16	2.70	1.70	749	2.02	1.27
23	1.31	2.64	1.32	1067	2.81	1.41
24	1.71	2.36	0.80	931	2.20	0.74
25	1.41	1.72	0.77	855	1.47	0.66
26				836		
27				746		
28		2.28	1.28	678	1.54	0.87
29		7.90	5.32	1026	8.10	5.45
30		7.30	4.40	534	3.89	2.35
Avg.	0.95	3.85	2.77	886		

NOTE: FERRIC CHLORIDE FEED AFTER RBC UNITS

TABLE E-10. PHOSPHORUS DATA, PEWAUKEE STP, OCTOBER 1975

Date	Fe/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1	0.10	4.76	5.94	818	7.97	4.85
2	0.94	2.16	1.18	799	1.72	0.94
3				783		
4				678		
5	0.80	1.80	0.83	655	1.17	0.54
6	0.58	1.20	0.40	651	0.78	0.26
7	0.47	1.12	0.27	886	0.99	0.24
8	0.68	0.90	0.25	488	0.44	0.12
9	1.29	0.66	0.15	897	0.59	0.14
10				871		
11				731		
12	0.73	1.47	0.43	681	0.99	0.29
13	0.65	1.64	0.47	939	1.54	0.44
14	0.67	3.24	0.17	1325	4.29	0.22
15	0.74	2.00	0.47	935	1.87	0.44
16	0.79	1.32	0.28	973	1.28	0.27
17				965		
18				852		
19	1.01	1.64	0.68	821	1.34	0.56
20	0.81	2.94	0.73	1249	3.67	0.91
21	1.26	1.32	0.46	746	0.98	0.34
22	1.69	2.36	0.36	783	1.85	0.28
23	1.54	2.28	0.23	791	1.80	0.18
24				836		
25				685		
26	1.01	NS	NS	829		
27	1.69	1.70	0.05	912	1.55	0.05
28	1.89	0.27	0.04	802	0.21	0.03
29	1.63	0.34	0.03	814	0.27	0.02
30	1.25	1.36	0.72	761	1.03	0.54
31				852		
Avg.	1.01	1.97	0.67	833		

NOTE: FERRIC CHLORIDE FEED AFTER RBC UNITS

TABLE E-11. PHOSPHORUS DATA, PEWAUKEE STP, NOVEMBER 1975

Date	Fe/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1				908		
2	0.04	NS	NS	NS	1340	
3	0.90	1.60	1.02	1030	1.65	1.05
4	1.52	3.03	0.48	931	2.82	0.44
5	1.95	1.48	0.50	878	1.30	0.44
6	2.03	1.70	0.50	825	1.40	0.41
7				806		
8				431		
9		6.28	3.32	871	5.46	2.88
10	1.09	2.16	1.07	1211	2.61	1.29
11	1.10	2.00	0.43	988	1.97	0.42
12	1.73	1.40	0.27	886	1.24	0.24
13	1.45	1.94	0.26	825	1.60	0.21
14				840		
15				715		
16	0.87	1.14	0.50	689	0.78	0.34
17	1.06	1.34	0.38	708	1.22	0.34
18	1.11	0.80	0.37	840	0.67	0.31
19	1.31	2.10	0.40	829	1.74	0.33
20	1.38	1.00	0.17	889	0.88	0.15
21				776		
22				678		
23	0.75	2.00	0.20	613	1.22	0.12
24	1.11	0.66	0.27	878	0.58	0.24
25	0.96	2.90	0.18	814	2.36	0.15
26	1.24	0.72	0.18	795	0.57	0.14
27	1.05	1.80	0.08	659	1.18	0.05
28				723		
29				1442		
30	0.75	1.12	0.08	1204	1.34	0.10
Avg.	1.17	1.86	0.53	871		

NOTE: FERRIC CHLORIDE FEED BEFORE RBC UNITS

TABLE E-12. PHOSPHORUS DATA, PEWAUKEE STP, DECEMBER 1975

Date	Fe/P Mole Ratio	Effluent Total P mg/l	Effluent Ortho P mg/l	Plant Flow m^3/day	Effluent Total P kg/day	Effluent Ortho P kg/day
1	1.40	1.16	0.06	1181	1.36	0.07
2	1.56	2.00	0.06	1060	2.12	0.06
3	0.65	2.44	0.29	1249	3.04	0.36
4	0.46	2.80	0.79	1211	3.39	0.95
5				912		
6				836		
7	1.08	1.20	0.24	780	0.93	0.19
8	1.54	24.8	0.40	958	23.73	0.38
9	1.63	1.60	0.08	905	1.44	0.07
10	1.52	0.60	0.07	878	0.53	0.06
11	1.60	1.32	0.01	863	1.13	0.01
12				1098		
13				984		
14	1.14	1.00	0.09	1011	1.01	0.09
15	1.62	8.12	0.16	1154	9.37	0.19
16	1.63	5.68	0.07	1098	6.23	0.08
17	1.65	3.00	0.09	1022	3.04	0.09
18	0.99	1.40	0.16	1101	1.54	0.18
19				984		
20				852		
21	0.75	1.40	0.12	810	1.13	0.09
22	0.88	20.5	1.38	942	19.31	1.30
23	0.96	2.30	0.09	852	1.96	0.07
24				761		
25				632		
26				674		
27				692		
28				712		
29				768		
30				749		
31				715		
Avg.	1.24	4.78	.22	916		

NOTE: FERRIC CHLORIDE FEED BEFORE RBC UNITS

APPENDIX F

TABLE F-1. ORGANIC REMOVAL DATA, PEWAUKEE STP, JANUARY 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1	8	7.52	82	63					55.8
2	11	7.08	88	76					61.5
3									57.0
4									55.4
5									56.2
6	12				85	73			62.7
7	12	6.84	89	74					62.7
8	12	8.45	66	33					72.1
9	10	30.95							108.8
10	10								142.2
11									107.1
12									78.2
13	9								99.4
14	9	8.54	95	90	94	87			68.0
15	8	4.64	93	69	95	77			63.1
16	9	5.66	94	83	95	85			56.6
17	9								59.5
18									48.5
19									47.7
20	9								68.4
21	9	6.35	90	72	94	78			59.5
22	10	13.38	82	63	91	74			72.1
23	10	7.62							69.3
24	11								79.4
25									91.3
26									43.6
27	11								51.3
28	10	8.84	74	67	81	70			78.2
29	11	3.91	91	83	89	78			44.4
30.	12	3.81							46.9
31	11								58.3
Avg.	11	8.84	86	69	92	77			68.4

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-2. ORGANIC REMOVAL DATA, PEWAUKEE STP, FEBRUARY 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1									68.9
2									68.4
3	11								42.4
4	12	5.42	90	81	89	78			47.3
5	12	5.91	84	66					61.9
6	11	10.55	87	87	89	86			61.1
7	10								46.4
8									62.3
9									68.4
10	11								55.0
11	10	4.39	68	41	83	65			51.7
12	10	6.79	83	78	82	77			51.7
13	9	5.22	81	72					50.9
14	10								70.5
15									62.7
16									70.1
17	10								55.0
18	12	4.05	94	85	89	72			62.7
19	11	7.18	87	77	89	79			66.4
20	11	6.69	75	57					73.3
21	11								53.8
22									72.1
23									59.5
24	11								68.4
25	8		80		75				71.7
26	10	6.30	84	84	75	63			64.0
27	9	4.78	82	59					61.9
28	10								68.0
Avg.	10	6.10	83	72	84	74			61.5

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-3. ORGANIC REMOVAL DATA, PEWAUKEE STP, MARCH 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal Total	Percent BOD Removal RBC	Percent COD Removal Total	Percent COD Removal RBC	Percent TOC Removal Total	Percent TOC Removal RBC	Hydraulic Loading m³/day/1000 m²
1									
2									59.1
3	10						99	93	46.4
4	11	6.49	74	65	80	61	94	83	63.6
5	11	5.91	83	65			84	67	63.6
6	10	4.88	80	60	81	59	89	74	58.3
7	10						86	65	61.1
8									57.9
9									39.9
10	10						97	81	82.3
11	10	9.23	86	72	89	77	53	44	86.4
12	10	6.69	77	69			90	83	85.1
13	10	7.23	81	74	83	72	67	57	70.9
14	10								63.1
15									56.6
16									70.1
17	11						90	67	79.0
18	10	20.31	18	46	2	36	70	56	113.3
19	8	7.08	57	5			16	64	152.8
20	11	3.86	57	0	75	0	83	0	162.6
21	11						81	4	184.2
22									198.8
23									110.8
24	10						40	0	154.4
25	10	14.45		37		55	0	36	200.4
26	10		71					65	172.7
27	10								112.0
28	10						88		114.9
29									145.9
30									126.7
31	10								122.6
							55	50	173.2
Avg.	10	8.59	68	49	68	51	71	61	106.3

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-4. ORGANIC REMOVAL DATA, PEWAUKEE STP, APRIL 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1	10	9176	10	28	44	58		52	130.4
2	10	7.32	37	23			51	41	128.3
3	10	5.22	46	16	64	65	47	51	118.2
4	10								113.3
5									109.2
6	10						89	74	104.7
7	10						60	53	125.9
8	10	11.08	37	46	59	48	74	77	123.4
9	11	8.64	65	51			46	60	115.7
10	11	8.79	70	67	75	63	40	57	112.4
11	11								111.2
12									95.7
13	11								88.8
14	11						40	32	99.0
15	10	4.69							92.5
16	11	8.30	82	79	74	71	60	70	95.3
17	12	5.42	88	83			51	66	90.0
18	12								112.4
19									88.8
20	11								93.3
21	11						83	78	96.6
22	11	8.01	77	83	90	92	28	61	93.3
23	11	9181	87	84	78	73	59	57	122.6
24	10	8.10	81	76			62	48	114.1
25	11								108.0
26									81.9
27	10						82		106.7
28	10						27	3	81.5
29	11	8.01	63	58	54	62	33	22	193.5
30	12	4.30	74	50	73	47	28	0	166.2
Avg.	11	7.32	63	57	68	64	52	53	110.4

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-5. ORGANIC REMOVAL DATA, PEWAUKEE STP, MAY 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal Total	Percent BOD Removal RBC	Percent COD Removal Total	Percent COD Removal RBC	Percent TOC Removal Total	Percent TOC Removal RBC	Hydraulic Loading m^3/day/1000 m^2
1	12	7.13	63	51			17	2	162.6
2	11								152.0
3									113.3
4							49	11	110.4
5	13						7	12	126.7
6	12	8.59	73	65	79	73	44	0	151.6
7	12	8.01	52	38	66	57	58	41	133.6
8	13	3.42	77	68			94	89	104.3
9	12								102.3
10									90.0
11								20	94.5
12	13						88	60	131.6
13	13	15.18	59	60	66	62	89	33	187.4
14	13	9.18	80	69	84	73	91	57	150.3
15	13	7.76	73	73			82	0	112.4
16	13								133.2
17									102.3
18							97	89	99.4
19	14						85	84	178.4
20	16	14.35	73	59	81	71	84	87	171.1
21	15	16.40	79	72	79	68	92	90	180.1
22	16	9.62	81	81			93	85	144.2
23	13								178.0
24									152.4
25							99	95	146.7
26	16						97	94	159.7
27	17	7.91	60	59	67	63	74	68	111.2
28	16	4.88	87	79	87	74	85	67	80.3
29	17	4.20	72	63			89	80	79.4
30	16								92.5
31									70.5
Avg.	14	8.98	71	64	77	67	76	61	129.2

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-6. ORGANIC REMOVAL DATA, PEWAUKEE STP, JUNE 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1							92	74	70.5
2	16						82	73	84.7
3	17	6.84	76	69	76	66	81	71	84.7
4	15	7.13	54	35	71	62	94	89	110.0
5	17	10.69	68	61			77	77	113.3
6	15								99.4
7									83.1
8							94		73.3
9	16						77		108.0
10	16	4.98	46	51	65	66	60	66	81.9
11	16	7.18	87	69	87	70	90	82	121.4
12	16	6.59	77	69			65	63	94.1
13	16								89.6
14									110.0
15							81	36	119.8
16	17						83	56	111.6
17	17	9.08	32	9	10	0	13	0	141.4
18	17	5.61	1	0	50	5	47	0	124.3
19	17	6.79	47	1			10	53	111.2
20	17								109.2
21									57.9
22							53	30	73.7
23	18						75	61	112.9
24	19	6.84	68	26	81	47	73	43	112.0
25	18	7.37	61	59	72	63	63	21	106.7
26	17	4.30	87	62			68	0	103.5
27	18								104.7
28	18								88.0
29	18						76	46	82.3
30	18						83	22	90.4
Avg.	17	6.98	59	42	64	47	73	57	98.2

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-7. ORGANIC REMOVAL DATA, PEWAUKEE STP, JULY 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1	18	9.08	61	36	62	37	69	32	109.2
2	18	5.71	78	49	82	61	85	62	111.6
3	20						0	43	98.6
4	19								95.3
5	21								101.0
6	19						87		103.5
7	20						85	68	102.3
8	21	8.74	68	52	78	65	90	82	101.4
9	19	6.79	75	47	83	61	84	73	100.6
10	18		81				87		97.4
11	19								105.9
12	19								87.6
13	19								85.6
14	19						85		79.4
15	19		56		76		70		101.0
16	19	6.98	73	19	85	53	70	26	104.7
17	19		74				80		113.3
18	19								123.0
19	21								99.4
20	20						86		90.9
21	20						68	38	116.9
22		7.57	82	57	85	53	80	0	104.3
23	19	6.15	73	0	83	28	87	19	113.3
24	19	6.49	75	54			83	57	97.0
25	20								88.0
26	20								77.4
27	20						92	0	72.5
28	21						90	60	74.1
29	21	3.76	82	53	84	56	77	51	74.6
30	20	3.71	84	51	87	61	74	4	74.6
31	20	5.13	73	18			76	31	84.7
Avg.	19	6.40	74	40	81	53	83	49	96.6

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-8. ORGANIC REMOVAL DATA, PEWAUKEE STP, AUGUST 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1	21								114.1
2	20								61.9
3	20						92		54.2
4	20						97	46	78.2
5	20	5.13	82	58	85	61	88	66	70.5
6	20	4.44	75	49	80	59	50	73	78.2
7	20						95	84	69.7
8	20								107.6
9	21								88.8
10	21						93	50	83.9
11	21				80	22	89	53	114.1
12	20	8.84	81	64	85	21	84	12	102.7
13	21	8.74	74	53			60	42	114.9
14	21	5.47	84	56			86	60	80.3
15	20								65.2
16	21								51.7
17	20						99	92	53.0
18	20						94	70	67.6
19	20				82	49	87	56	72.5
20	20	8.10	58	41	62	40	63	25	95.3
21	21	5.13	83	55			80	32	97.0
22	20								117.3
23	20								83.1
24	20						94	79	68.9
25	20						80	68	89.2
26	21	5.03	62	27	70	42	84	76	81.1
27	20	4.54	80	51	86	60	82	63	72.1
28	20	6.74	81	66			75	46	72.1
29	20								71.3
30	19								56.2
31	20						83	83	51.3
Avg.	20	6.20	76	52	79	44	83	59	80.3

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-9. ORGANIC REMOVAL DATA, PEWAUKEE STP, SEPTEMBER 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal Total	Percent BOD Removal RBC	Percent COD Removal Total	Percent COD Removal RBC	Percent TOC Removal Total	Percent TOC Removal RBC	Hydraulic Loading m^3/day/1000 m^2
1	19						79		61.1
2	20	7.86	85	77	84	74	58	51	63.1
3	20		77		79		80		64.0
4	20	8.45	77	51			91	80	78.2
5	20								103.5
6	19								53.4
7	19						98		49.7
8	20						97	93	56.6
9	20		93				77		56.2
10	20	4.00	83	63	90		82	56	59.5
11	20	9.52	86	85	86	74	88	81	54.2
12	19								49.3
13	18								40.3
14	18						86	75	40.3
15	19						77	67	50.1
16	19	4.78	88	79			82	76	45.2
17	19	6.35	91	83	90	85	92	74	44.4
18	19	5.47	84	76	94	85	88	76	44.4
19	19								42.4
20	18								38.7
21	18						90		36.3
22	18						87	78	44.4
23	18	10.06	85	73			85	57	63.1
24	19	9.86	85	77	85	72	89	80	55.0
25	18	6.44	89	83	86	78	89	87	50.5
26	18								49.3
27	18								44.0
28	18							99	39.9
29	18						85		60.7
30	20	1.81	79	2	77	0	81	0	31.4
Avg.	19	6.79	85	68	86	67	85	75	52.1

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-10. ORGANIC REMOVAL DATA, PEWAUKEE STP, OCTOBER 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal Total	Percent BOD Removal RBC	Percent COD Removal Total	Percent COD Removal RBC	Percent TOC Removal Total	Percent TOC Removal RBC	Hydraulic Loading m^3/day/1000 m^2
1	16	8.25	54	32	47	23	62	47	48.1
2	18	7.67	86	82			87		47.3
3	18								53.0
4	18								45.6
5	18						94		44.0
6	17						93		44.0
7	20	7.76	98	92	94	68	97	82	59.9
8	19	2.93	96	80	98	81	98	81	33.0
9	19	6.88	97	93			96	87	53.0
10	19								51.3
11	17								43.2
12	17						97		40.3
13	19						94	65	55.4
14	20	11.86	73	44	81	49	79	21	78.2
15	19	8.06	89	81	94	87	97	92	55.0
16	18	4.39	97	87			92	63	57.4
17	18								57.0
18	18								50.1
19	17						90		48.5
20	18						92	86	84.3
21	19	6.10	96	89	93	85	94	87	50.1
22	19	5.52	88	70	91	78	85	61	53.0
23	17	7.96	80	66			84	66	53.4
24	17								56.2
25	17								46.0
26	16								55.8
27	16						88	73	61.5
28	17	6.74	99	95	98	91	98	91	54.2
29	17	6.10	98	89	98	89	95	73	55.0
30	18	5.91	95	78			94	69	51.3
31	17								57.4
Avg.	18	6.88	91	77	92	72	90	72	53.0

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-11. ORGANIC REMOVAL DATA, PEWAUKEE STP, NOVEMBER 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal Total	Percent BOD Removal RBC	Percent COD Removal Total	Percent COD Removal RBC	Percent TOC Removal Total	Percent TOC Removal RBC	Hydraulic Loading $m^3/day/1000\ m^2$
1	17								61.1
2	17								90.4
3	17						89	69	69.3
4	16	9.37	70	50	59	45	63	55	62.7
5	17	21.68	90	92	94	96	85	94	59.1
6	16	17.58	83	88			83	93	55.8
7	16								54.2
8	16								28.9
9	16						89	55	58.7
10	14						93	89	77.0
11	16	14.65	88	84	88	85	86	84	66.8
12	16	10.79	91	83	91	86	89	82	59.9
13	16	7.23	80	52			83	53	55.8
14	16								56.6
15	17								48.1
16	16						96	73	46.4
17	16						88	80	61.1
18	18	8.79	95	88			96	91	56.6
19	16	11.91	86	74	94	85	87	80	55.8
20	16	10.01	94	86	95	89	98	96	59.9
21	16								52.1
22	15								45.6
23	15						98		48.9
24	15						98	89	59.1
25	15	8.64	90	59	91	61	96	72	55.0
26	15						99	83	53.8
27	15						95	64	44.4
28	13								48.9
29	13								97.4
30	13						96	81.1	
Avg.	16	12.06	87	76	87	78	90	78	58.7

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE F-12. ORGANIC REMOVAL DATA, PEWAUKEE STP, DECEMBER 1975

Date	Raw Water Temp. °C	Organic Loading *	Percent BOD Removal		Percent COD Removal		Percent TOC Removal		Hydraulic Loading m^3/day/1000 m^2
			Total	RBC	Total	RBC	Total	RBC	
1	13						94	97	79.4
2	12	9.28	78	60	83	58	74	42	71.3
3	13	24.51	74	79	75	84	82	88	84.3
4	14	256.33	74	97			75	98	81.5
5	12								61.5
6	12								56.2
7	12						93	99	52.6
8	14							26	64.8
9	14	8.84	90	81	84	69	91	82	61.1
10	13	5.71	93	82	93	81	89	68	59.1
11	14	92.28	81	97			83	98	58.3
12	14								74.1
13	13								66.4
14	14						94	98	68.0
15	14							98	77.8
16	11	253.89	62	98	77	99	8	99	74.1
17	9	17.47	76	79	72	81	62	96	68.9
18	13	23.63	84	90			85	98	74.1
19	12								66.4
20	13								57.4
21	13						98	99	54.6
22	13						19	90	63.6
23	13		93				98	99	57.4
24	12								51.3
25	10								42.8
26	10								45.6
27	10								46.9
28	10								48.1
29	10								51.7
30	12								50.5
31	12								
Avg.	12	76.95	81	85	81	79	76	87	61.9

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

APPENDIX G

TABLE G-1. FINAL EFFLUENT DATA, PEWAUKEE STP, JANUARY 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1								
2	45							
3	32							
4								
5				14				
6		52		10				0.02
7	29			20				
8	78			23	4.4			0.04
9	37			30				
10								
11								
12				22	3.5			
13				23				0.14
14	13	31	30					
15	23	39		36				
16	17	29		33				0.17
17								
18								
19				27				
20				28				
21	30	45		34				0.18
22	69	76		87	4.7			
23	73			73				0.21
24								
25								
26				27				0.15
27				48	3.6			
28	38	73		48				
29	15	46		18				
30								
31								
Avg.	38	49		33	4.0			0.12

TABLE G-2. FINAL EFFLUENT DATA, PEWAUKEE STP, FEBRUARY 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1								
2								
3				26				0.11
4	21	56		39				
5	32			30	3.9			0.78
6	22	48		34				
7								
8								
9				41	4.2			
10				43				0.67
11	50	68		60				
12	28	66		40				0.72
13	29			48				
14								
15								
16				54	2.5			
17				58				0.76
18	10	45		26				
19	24	51		36				
20	39			54				1.18
21								
22								
23				63	3.1			0.88
24								
25	25	90		82				
26	16	94		49				
27	32			48				2.34
28								2.34
Avg.	27	65		46	3.4			1.09

TABLE G-3. FINAL EFFLUENT DATA, PEWAUKEE STP, MARCH 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1								
2			2	46				
3			7	48	2.2			
4	36	76	14	48				3.20
5	35		10	54				4.06
6	32	59	18	50				
7								
8								
9			12	32				
10			42	78	0.8			0.77
11	31	50	12	44				
12	28		26	39				1.03
13	30	57	30	55				
14								
15								
16			20	97	0.8			0.33
17			28	56				
18	72	232	47	144				
19	42		6	76				0.80
20	33	42	23	82				
21								
22								
23			32	90	1.1			0.81
24			64	122				0.79
25	53	102	24	78				
26	55		31	86				
27	25		11	50				
28								
29								
30								
31			34	64	1.3			0.76
Avg.	40	88	22	68	1.2			1.33

TABLE G-4. FINAL EFFLUENT DATA, PEWAUKEE STP, APRIL 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1	58	81	28	81				
2	28		23	63				1.48
3	42	59	23	67				
4								
5								
6			10	52	2.3			1.58
7			25	48				1.66
8	44	98	11	62				
9	30		20	30				
10	37	67	27	40				
11								
12								
13								
14			21	27				
15								
16	19	59	17	40	4.2			1.04
17	14		26	26				0.97
18								
19								
20								
21			17	45				1.65
22	11	17	31	22				1.47
23	16	47	25	32				
24	15		32	31	4.7			
25								
26								
27			14	53				2.35
28			35	72	3.1			
29	23	48	31	26				
30	10	36	36	19				1.53
Avg.	27	57	24	44	3.6			1.53

TABLE G-5. FINAL EFFLUENT DATA, PEWAUKEE STP, MAY 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1	22		39	30				
2								
3								
4			48	30	3.5			
5			42	30				1.97
6	20	32	10	32				2.23
7	37	52	10	31				
8	10		1	13				
9								
10								
11			4	18	3.6			0.62
12			4	32				
13	32	66	4	31				0.91
14	19	44	3	24				
15	19		7	34				
16								
17								
18			3	17	3.0			
19			6	50				1.97
20	34	51	6	29				
21	24	71	4	27				
22	13		3	16				0.70
23								
24								
25			1	20				1.05
26			2	35	3.1			
27	29	61	12	37				0.63
28	13	39	12	21				
29	20		6	25				
30								
31								
Avg.	22	52	9	27	3.3			1.26

TABLE G-6. FINAL EFFLUENT DATA, PEWAUKEE STP, JUNE 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1			10	36				
2			11	31	1.9			0.90
3	25	60	12	30				
4	42	67	4	54				
5	36		12	49				1.33
6								
7								
8			7	26				0.80
9			20	51	1.4			
10	29	59	19	39				
11	18	40	6	21				0.70
12	22		18	28				
13								
14								
15			16	42	1.8			0.55
16			22	75	1.5			0.90
17	58	184	52	142	1.2			
18	60	108	24	80	1.2			
19	60		16	78	1.5			
20								
21								
22			16	34	2.6			
23			17	47	0.6			
24	45	79	20	40	1.4			0.20
25	28	66	19	55	1.7			
26	16		25	19	1.7			0.24
27								
28								
29			15	24	3.0			
30			21	34	3.0			0.16
Avg.	37	83	30	47	1.7			0.64

TABLE G-7. FINAL EFFLUENT DATA, PEWAUKEE STP, JULY 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1	53	117	27	41	2.2	4.4	8.0	0.04
2	26	49	11	22	2.5	2.8	3.3	
3			44	102	0.2	10.5	16.6	
4								
5								
6			20	24	1.2	8.6	10.7	
7			24	40	0.8	5.7	8.1	
8	41	69	9	32	1.5	7.2	9.4	
9	36	61	14	37	2.0	7.2	10.8	0.89
10	34		15	62	2.3	9.7	13.7	1.35
11								
12								
13								
14			18	30	1.5	8.5	10.8	
15	61	90	23	58	1.1	6.9	10.4	1.36
16	40	61	28	35	1.6	6.7	11.4	0.66
17	40		19	34	2.4	6.6	9.6	
18								
19								
20			18	42	1.2	8.3	12.8	0.41
21			36	58	0.6	5.4	10.0	0.70
22	31	77	27	37	0.6	6.6	10.4	
23	54	98	17	46	1.2	5.0	8.3	
24	31		12	24	1.9	5.2	10.1	
25								
26								
27			25	40	2.3	8.5	12.3	
28			18	31	1.0	5.7	9.2	0.10
29	24	56	23	28	1.3	7.7	10.0	0.05
30	24	44	25	14	2.0	5.2	7.2	
31	49		25	30	1.8	5.4	7.9	
Avg.	39	72	19	39	1.5	6.7	10.1	0.62

TABLE G-8. FINAL EFFLUENT DATA, PEWAUKEE STP, AUGUST 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Al mg/l
1								
2								
3			10	14	2.9	12.2	13.4	
4			14	40	2.0	7.4	11.2	
5	31	64	10	33	0.6	0	2.0	
6	29	57	6	27	0.8	7.5	9.8	1.08
7			4	25	0.6	8.0	9.6	1.00
8								
9								
10			19	42	0.3	11.3	14.6	
11		108	17	54	01.	7.4	11.2	
12	31	107	22	65	0.1	8.6	12.9	0.98
13	36		21	46	0.1	8.8	12.6	1.18
14	30		12	46	0.1	10.1	16.4	
15								
16								
17			2	15	0.2	14.6	16.5	0.12
18			9	44	0.3	9.6	12.0	1.52
19		80	14	49	0.3	7.2	9.8	
20	50	106	27	52	0.6	10.6	13.5	
21	24		19	48	0.8	12.3	14.6	
22								
23								
24			10	43	1.0	7.2	8.5	
25			17	64	2.3	4.6	7.4	
26	45	66	8	49	3.0	3.6	5.4	0.72
27	31	46	11	29	3.9	5.0	6.3	1.06
28	32		21	28	3.3	5.2	6.3	
29								
30								
31			9	21	4.2	3.5	4.5	
Avg.	34	79	13	40	1.3	8.2	10.4	0.96

TABLE G-9. FINAL EFFLUENT DATA, PEWAUKEE STP, SEPTEMBER 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Fe mg/l
1			23	10	3.8	2.5	3.5	0.80
2	29	47	23	23	4.5	5.1	6.5	0.80
3	38	49	13	26	3.5	2.6	8.7	0.80
4	53		10	47	3.2	1.7	4.3	
5								
6								
7			18	48	4.8	3.5	5.9	3.40
8			7	23	4.9	8.6	10.1	4.30
9	13	26	14	22	5.6	6.3	8.2	
10	25	38	20	32	5.8	3.9	5.5	
11	26		17	34	5.8	4.3	6.5	
12								
13								
14			16	30	6.0	5.8	7.3	
15			27	30	4.9	6.3	7.8	
16	22	37	16	21	5.9	6.5	7.4	2.50
17	25	39	22	20	5.7	7.2	8.6	0.80
18	30		13	24	6.0	5.4	6.7	
19								
20								
21			27	63	6.3	4.6	7.8	
22			21	37	5.1	5.9	7.6	
23	43	77	28	46	1.3	10.0	12.5	3.00
24	41	75	18	64	2.1	8.9	11.4	4.00
25	22		17	40	0.9	7.8	9.2	
26								
27								
28			11	28	1.0	11.6	12.9	
29			39	97	0.6	8.8	14.0	
30	57	145	46		1.0	10.7	16.8	
Avg.	33	59	20	36	4.0	6.3	8.6	2.30

TABLE G-10. FINAL EFFLUENT DATA, PEWAUKEE STP, OCTOBER 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Fe mg/l
1	116	298	71	140	1.3	7.9	13.5	5.2
2	29		23	35	1.3	9.3	10.1	
3								
4								
5			29	42	0.8	7.5	8.6	3.0
6			19	26	1.5	8.4	9.1	
7	10	86	13	17	1.7	10.4	11.7	
8	18	37	10	12	2.4			3.5
9	9		9	20	1.5	10.3	11.1	
10								
11								
12			10	26	3.2	7.9	9.3	4.0
13			17	21	1.7	6.2	7.8	
14	85	155	56	61	0.4	9.2	12.9	8.6
15	28	36	6	39	2.0	6.5	8.4	
16	10		16	23	1.7	8.0	9.5	
17								
18								
19			20	30	1.2	13.0	15.1	
20			14	60	1.7	9.8	13.7	8.6
21	13	37	9	28	1.2	12.9	14.0	
22	31	51	26	51	2.0	10.0	12.6	7.0
23	50		27	54	2.6	9.3	11.8	
24								
25								
26								
27			26	38	2.4	7.6	10.1	10.0
28	6	20	7	21	1.7			
29	12	23	16	25	2.1	11.2	12.3	4.0
30	26		22	23	2.0	6.7	8.0	
31								
Avg.	32	83	21	38	1.8	9.0	11.0	6.0

TABLE G-11. FINAL EFFLUENT DATA, PEWAUKEE STP, NOVEMBER 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Fe mg/l
1								
2								
3			35	27	0.9	7.8	9.2	2.5
4	75	154	37	120	2.8	8.2	13.8	
5	31	30	16	40	1.2	9.2	10.9	
6	37		18	52	1.4	10.0	15.7	4.2
7								
8								
9			58	140	0.8	8.3	14.0	6.5
10			18	55	0.9	9.5	11.3	
11	35	71	29	78	1.2	8.6	11.4	5.0
12	31	50	22	42	1.5	8.6	11.9	
13	62		38	84	2.3	8.5	11.9	
14								
15								
16			20	26	1.1	10.3	13.3	
17			19	38	1.3	8.8	10.7	2.5
18	18		12	21	1.5	9.8	12.4	1.5
19	55	47	32	67	1.6	10.0	13.6	
20	24	40	4	30	1.5	8.6	10.2	
21								
22								
23			29	69	3.2	8.7	12.7	
24			12	24	2.3	7.3	8.3	
25	65	111	36	98	1.5	9.5	14.0	6.8
26			17	30	2.0	9.5	11.2	2.6
27			29	64	3.9	10.0	13.2	
28								
29								
30			27	50	3.0	2.4	4.4	4.0
Avg.	43	72	25	58	1.8	8.7	11.7	4.0

TABLE G-12. FINAL EFFLUENT DATA, PEWAUKEE STP, DECEMBER 1975

Date	BOD mg/l	COD mg/l	TOC mg/l	SS mg/l	NO_3-N mg/l	NH_3-N mg/l	TKN mg/l	Fe mg/l
1			15	51	2.3	4.7	7.0	4.5
2	52	91	48	90	2.7	7.7	11.2	
3	61	122	37	91	1.2	6.3	11.8	
4	78		70	107	0.7	8.1	13.9	
5								
6								
7			30	45	0.4	13.3	16.1	
8			518	958	0	5.6	42.6	
9	27	90	21	76	1.4	8.4	11.2	5.0
10	17	43	27	24	1.1	9.1	14.1	
11	51		44	75	0.6	11.3	17.6	5.0
12								
13								
14			31	42	0.5	6.2	9.8	
15			130	312	0.3	3.4	33.3	24.3
16	82	123	108	226	1.0	5.7	13.7	
17	56	142	47	106	1.0	6.9	12.0	7.5
18	32		40	65	0.8	6.8	10.2	
19								
20								
21			29	47	0.6	8.1	11.2	3.5
22			268	850	0.2	11.2	46.5	52.0
23	38		35	67	0.9	9.3	12.9	
24								
25								
26								
27								
28								
29								
30								
31								
Avg.	49	102	88	190	0.9	7.8	17.4	14.5

APPENDIX H

TABLE H-1. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE TRICKLING FILTER, 1973

Month	Raw Water Temp. °C	Avg. Flow m^3/day	BOD mg/l			Percent BOD Removal		S.S. mg/l			Percent Total Susp. Solids Removal	Hydraulic Loading m^3/day/m^2	Organic Loading *
			Raw	Primary	Final	Total	T.F.	Raw	Primary	Final			
JAN.	10.0	450	141	66	24	53	83	-	-	-	-	1.26	48
FEB.	8.7	587	168	97	48	42	71	-	-	-	-	1.65	92
MAR.	9.6	950	149	104	30	30	80	-	-	-	-	2.66	159
APR.	10.4	1223	124	56	24	55	81	-	-	-	-	3.42	110
MAY	11.8	916	110	77	33	30	70	-	-	-	-	2.56	113
JUNE	15.6	742	141	93	41	34	71	-	-	-	-	2.08	111
JULY	19.1	712	184	129	43	30	77	-	-	-	-	1.99	148
AUG.	20.0	575	160	85	41	47	74	-	-	-	-	1.61	79
SEPT.	19.1	469	186	81	28	56	85	-	-	-	-	1.31	61
OCT.	17.5	1586	167	115	41	31	75	-	-	-	-	4.44	293
NOV.	14.6	848	192	116	55	40	71	-	-	-	-	2.38	158
DEC.	12.3	912	129	76	21	41	84	-	-	-	-	2.55	111
AVG.	14.1	746	154	91	36	41	77	-	-	-	-	2.33	124

NOTE: *Organic loading expressed as g primary BOD/day per m^3 of trickling filter volume (i.e. g/day/m^3).

TABLE H-2. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE TRICKLING FILTER, 1974

Month	Raw Water Temp. °C	Avg. Flow m^3/day	BOD mg/l			Percent BOD Removal		S.S. mg/l			Percent Total Susp. Solids Removal	Hydraulic Loading m^3/day/m^2	Organic Loading *
			Raw	Primary	Final	Total	T.F.	Raw	Primary	Final			
JAN.	10.4	871	135	105	57	58	46	-	-	-	-	2.43	147
FEB.	9.7	814	132	91	62	53	32	-	-	-	-	2.27	119
MAR.	9.6	2036	77	72	46	40	36	-	-	-	-	5.70	236
APR.	10.4	1874	88	101	29	67	71	-	-	-	-	5.25	304
MAY	13.2	2850	98	128	35	64	73	-	-	-	-	7.98	586
JUNE	15.7	1900	147	148	36	76	76	90	108	43	52	5.32	425
JULY	18.8	874	189	149	29	85	81	110	236	40	64	2.45	209
AUG.	19.8	700	215	243	64	70	74	136	299	63	54	1.96	273
SEPT.	19.1	348	275	240	48	83	80	244	264	74	70	0.97	134
OCT.	17.2	72	531	305	74	86	76	430	424	120	72	0.21	35
NOV.	13.4	488	176	194	60	66	69	118	170	67	43	1.37	152
DEC.	11.3	363	150	115	44	71	62	140	154	60	57	1.02	67
AVG.	14.1	1099	184	158	49	71	57	181	236	67	59	3.08	226

NOTE: *Organic loading expressed as g primary BOD/day per m^3 of trickling filter volume (i.e. g/day/m^3).

TABLE H-3. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE TRICKLING FILTER, 1976

Month	Raw Water Temp. °C	Avg. Flow m^3/day	BOD mg/l			Percent BOD Removal		S.S. mg/l			Percent Total Susp. Solids Removal	Hydraulic Loading m^3/day/m^2	Organic Loading *
			Raw	Primary	Final	Total	T.F.	Raw	Primary	Final			
JAN.	10.1	416	283	139	58	80	51	389	79	45	88	1.17	93
FEB.	9.7	662	330	96	50	71	85	664	72	40	94	1.85	102
MAR.	9.3	1514	248	92	33	63	87	531	58	33	94	4.24	224
APR.	10.6	969	306	59	25	81	92	496	82	41	92	2.71	92
MAY	12.2	799	280	82	15	71	95	327	79	39	88	2.24	105
JUNE	15.7	625	255	99	43	61	83	303	65	39	87	1.75	99
JULY	17.2	568	220	97	42	56	81	319	62	34	89	1.59	88
AUG.	18.3	590	187	112	59	40	68	182	66	29	84	1.66	106
SEPT.	19.3	481	149	105	46	30	69	160	73	25	84	1.35	81
OCT.	15.5	666	245	108	66	56	73	347	63	38	89	1.86	116
NOV.	12.8	447	302	105	44	65	85	381	42	25	93	1.25	75
DEC.	9.9	447	277	128	68	54	75	294	82	47	84	1.25	92
AVG.	13.4	682	257	102	46	62	73	366	69	36	89	1.91	106

NOTE: *Organic loading expressed as g primary BOD/day per m^3 of trickling filter volume (i.e. g/day/m^3).

APPENDIX I

TABLE I-1. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, 1973

Month	Raw Water Temp. °F	Avg. Flow m³/day	BOD mg/l Raw	BOD mg/l Primary	BOD mg/l Final	Percent BOD Removal Total	Percent BOD Removal RBC	S.S. mg/l Raw	S.S. mg/l Primary	S.S. mg/l Final	Percent Total Removal	Hydraulic Loading m³/day/1000 m²	Organic Loading *
JAN.	10.0	2366	141	113	28	80	75	-	-	-	-	139.6	15.77
FEB.	8.7	1987	170	142	35	79	75	-	-	-	-	117.3	16.65
MAR.	9.6	1544	148	123	36	76	71	-	-	-	-	91.1	11.18
APR.	10.4	2600	124	113	29	77	74	-	-	-	-	153.4	17.33
MAY	11.8	2100	110	104	31	72	70	-	-	-	-	123.9	12.89
JUNE	15.6	1211	141	101	26	82	74	-	-	-	-	71.5	7.23
JULY	19.1	617	184	130	25	86	81	-	-	-	-	36.4	29.00
AUG.	20.0	727	160	101	16	90	84	-	-	-	-	42.9	4.35
SEPT.	19.1	859	185	117	19	90	84	-	-	-	-	50.7	5.91
OCT.	17.5	757	167	174	24	86	86	-	-	-	-	44.7	7.76
NOV.	14.6	942	192	151	30	84	80	-	-	-	-	55.6	8.40
DEC.	12.3	1294	129	103	25	81	76	-	-	-	-	76.4	7.86
AVG.	14.1	1417	154	123	27	82	78	-	-	-	-	83.6	12.01

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE 1-2. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, 1974

Month	Raw Water Temp. °F	Avg. Flow m^3/day	BOD mg/l			Percent BOD Removal		S.S. mg/l			Percent Total Removal	Hydraulic Loading m^3/day/1000 m^2	Organic Loading *
			Raw	Primary	Final	Total	RBC	Raw	Primary	Final			
JAN.	10.4	988	135	114	29	-	-	-	-	-	-	58.3	6.64
FEB.	9.7	942	132	100	32	-	-	-	-	-	-	55.6	5.56
MAR.	9.6	2154	77	89	25	68	72	-	-	-	-	127.1	11.31
APR.	10.4	1809	88	111	31	65	72	-	-	-	-	106.8	11.85
MAY	13.2	1253	98	106	28	71	74	-	-	-	-	73.9	7.84
JUNE	15.7	852	143	62	23	84	63	90	50	7	92	50.3	3.12
JULY	18.8	931	189	87	31	84	64	110	77	25	77	54.9	4.78
AUG.	19.8	492	215	123	28	87	77	136	129	28	79	29.0	3.57
SEPT.	19.1	643	275	147	60	78	59	244	94	36	85	37.9	5.58
OCT.	17.2	1098	531	113	50	91	56	386	82	35	91	64.8	7.32
NOV.	13.4	889	176	105	18	90	83	128	78	24	81	52.5	5.51
DEC.	11.3	1094	150	101	22	85	78	140	83	24	83	64.6	6.52
AVG.	14.1	1095	184	105	31	80	70	176	75	26	84	64.6	6.64

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).

TABLE I-3. TREATMENT SUMMARY, VILLAGE OF PEWAUKEE RBC PLANT, 1976

Month	Raw Water Temp. °F	Avg. Flow m^3/day	BOD mg/l			Percent BOD Removal		S.S. mg/l			Percent Total Removal	Hydraulic Loading m^3/day/1000 m^2	Organic Loading *
			Raw	Primary	Final	Total	RBC	Raw	Primary	Final			
JAN.	10.1	731	232	250	24	90	90	390	426	22	94	49.3	12.30
FEB.	9.7	1238	346	225	28	92	88	630	349	43	93	83.5	18.75
MAR.	9.3	2176	262	204	33	87	84	531	451	61	89	146.7	29.93
APR.	10.6	1605	306	208	31	90	85	496	315	44	91	108.4	22.51
MAY	12.2	1400	281	204	26	91	87	327	395	30	91	94.5	19.23
JUNE	15.7	1037	255	218	22	91	90	303	269	26	91	70.1	12.64
JULY	17.2	765	220	221	14	94	94	315	305	21	93	51.7	11.37
AUG.	18.3	674	187	124	19	90	85	182	92	16	91	79.4	9.86
SEPT.	19.3	844	175	122	31	82	75	179	90	24	86	99.8	12.15
OCT.	15.5	413	245	147	24	90	84	347	80	24	93	48.9	7.18
NOV.	12.8	689	325	138	19	94	86	389	76	21	95	81.5	11.23
DEC.	9.9	723	277	146	27	90	82	294	115	25	91	85.1	12.45
AVG.	13.4	1024	259	184	25	90	86	365	247	30	92	83.1	14.99

NOTE: *Organic loading expressed as kg primary BOD/day per 1000 sq. m. of RBC surface area (i.e. organic loading to RBC units).